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The INSTITUTION *of* PRODUCTION ENGINEERS

JOURNAL

(*December* 1943, *Vol. XXII, No.* 12, *Ed. B*)

CONTENTS

ORGANISATION AND CONTROL OF PRODUCTION

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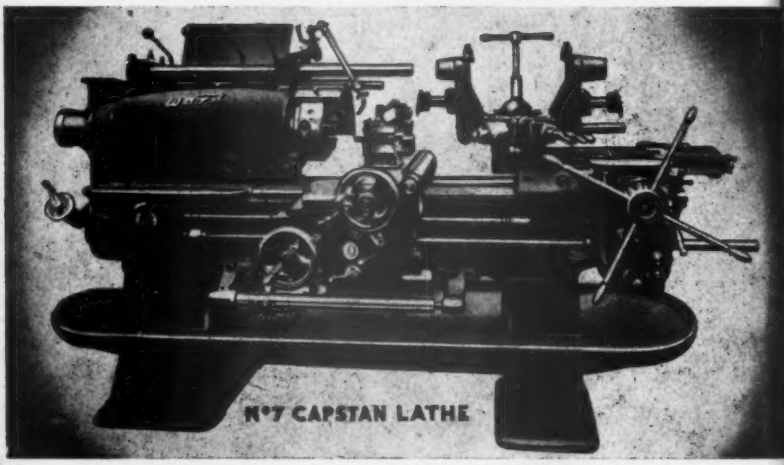

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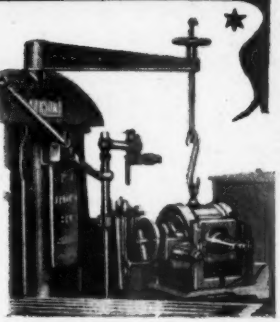

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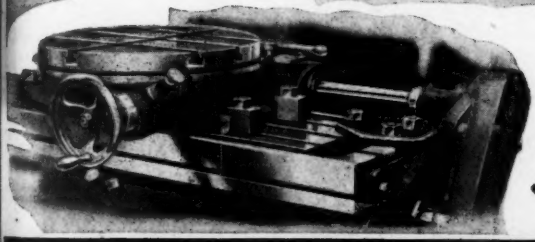

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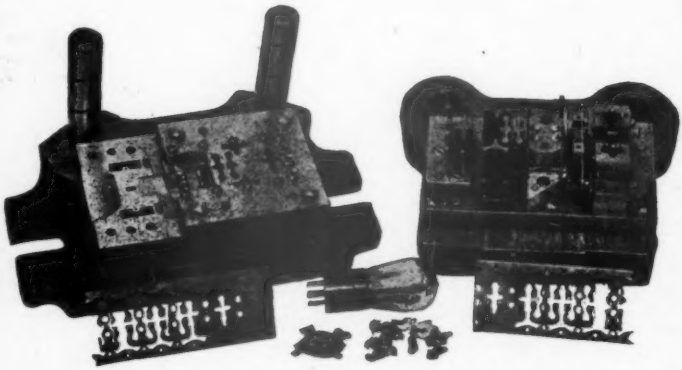

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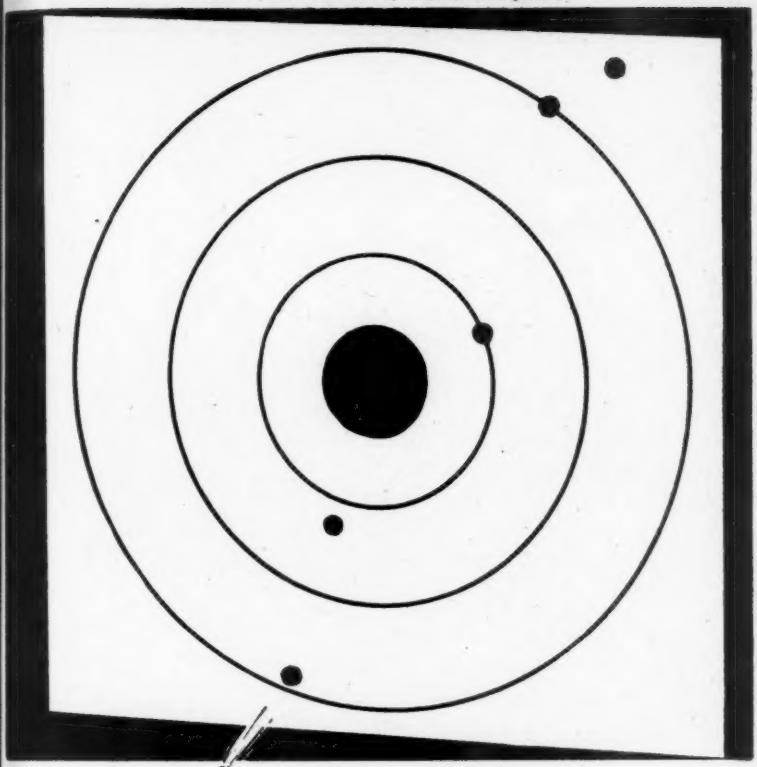

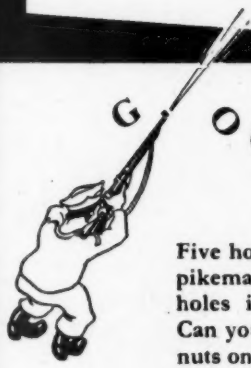

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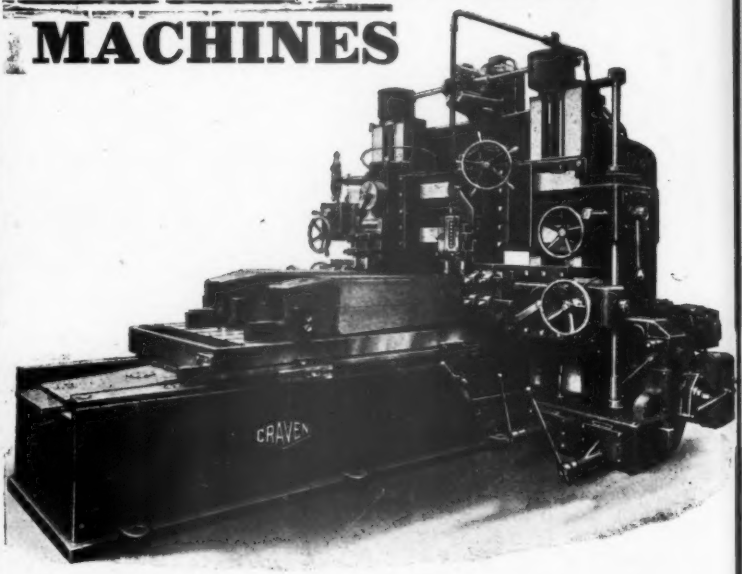

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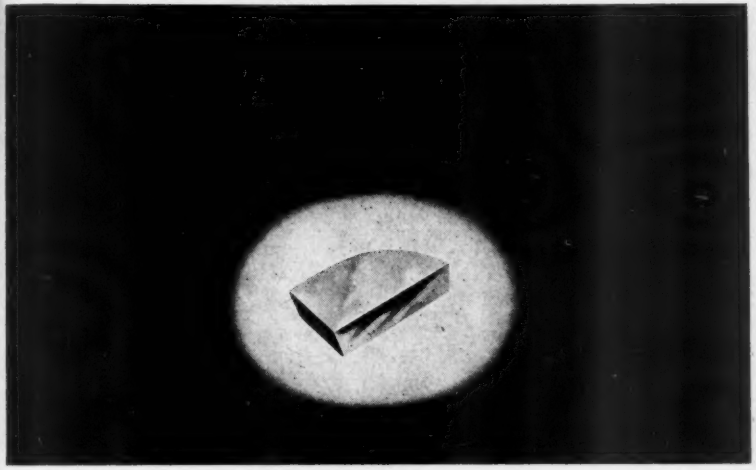

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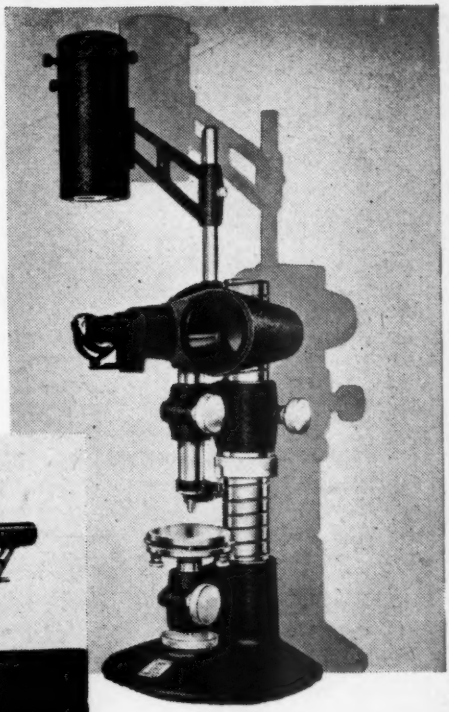

Vertical Model

With 1000 to 1 magnification and scale graduations in divisions of 0·00005"

Range of Scale	±0·005"
Graduations	0·00005"
Max. Height of Work ...	7"
Max. Dia. of Work	6"

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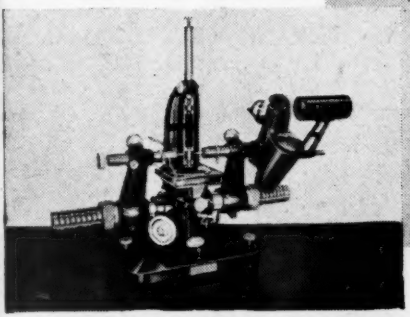
For external and internal work including measuring internal threads with 1000 to 1 magnification and graduations of 0·00005"

Max. External Dia. of Work ...	14"
Max. Internal Dia. of Work ...	6"
Min. " " " " ...	$\frac{11}{16}$"
Max. Pitch Dia. of Internal Thread	$3\frac{1}{16}$"



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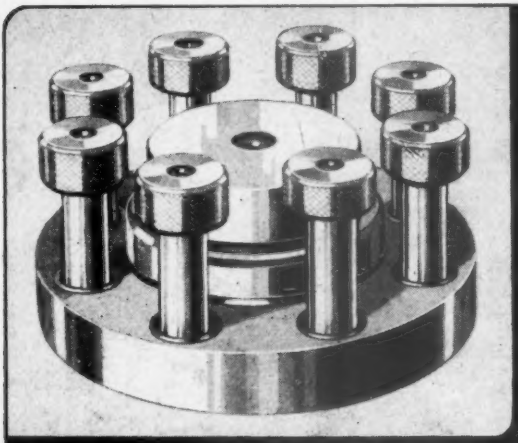

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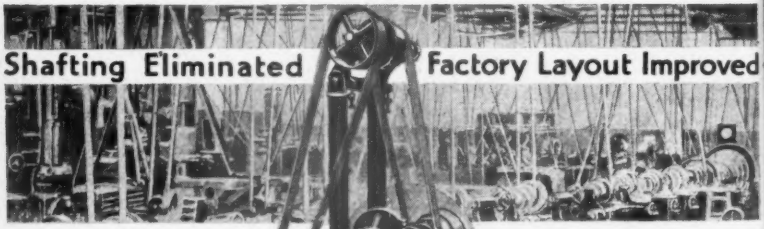

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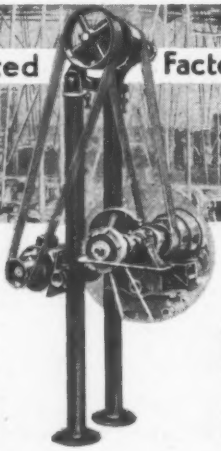

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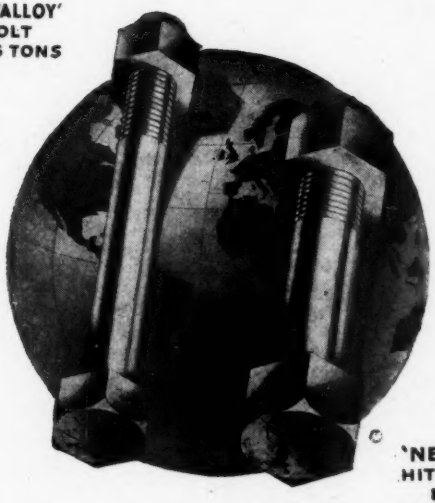

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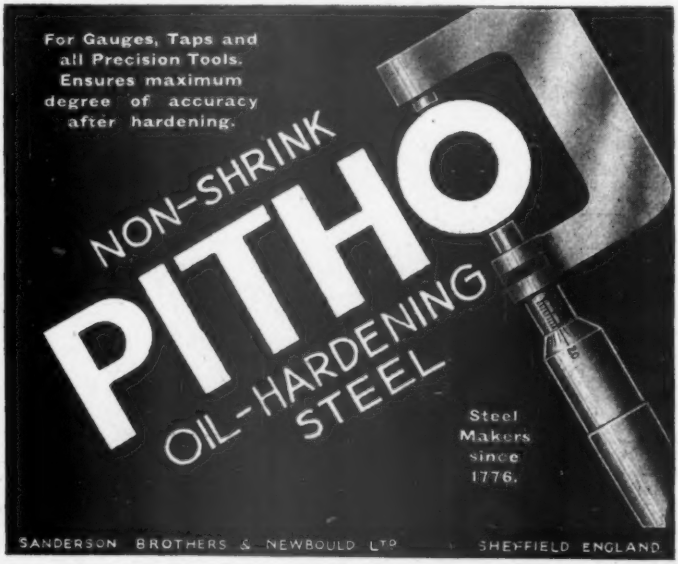
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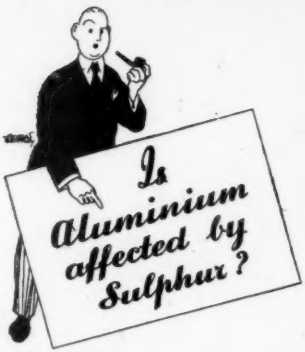

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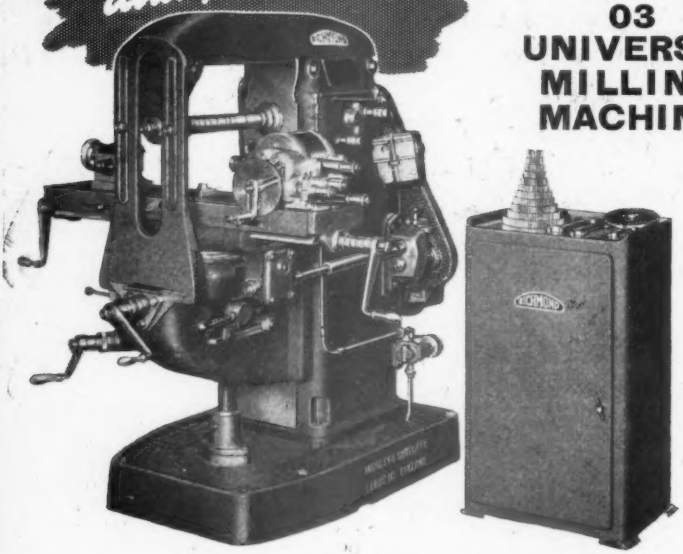

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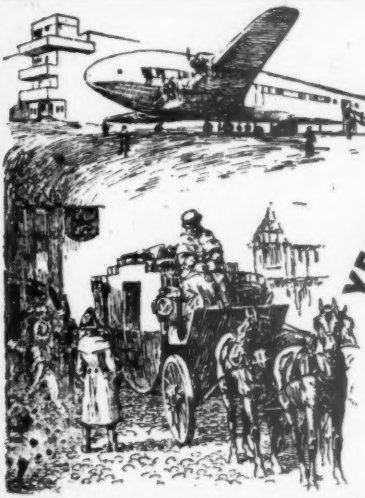

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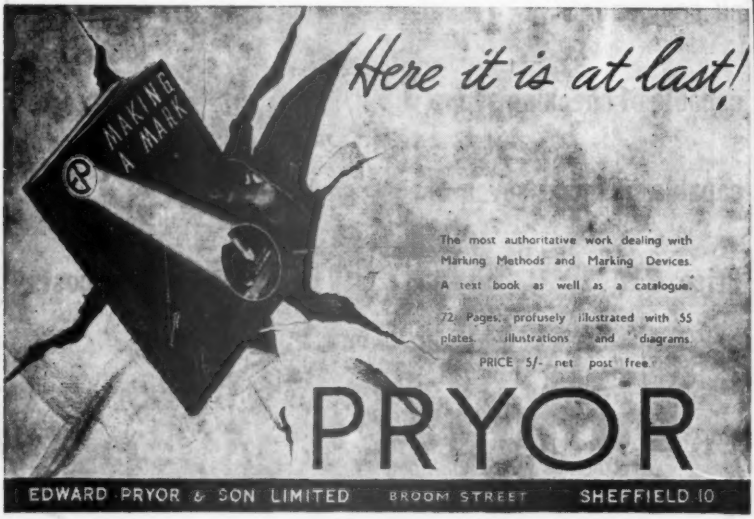
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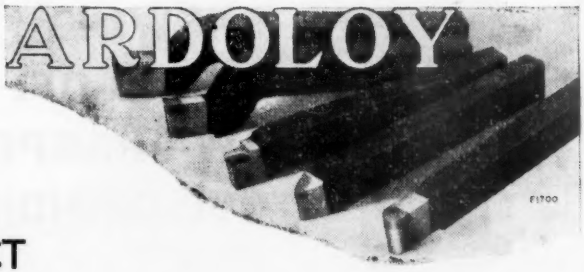

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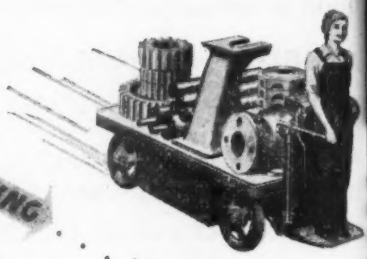

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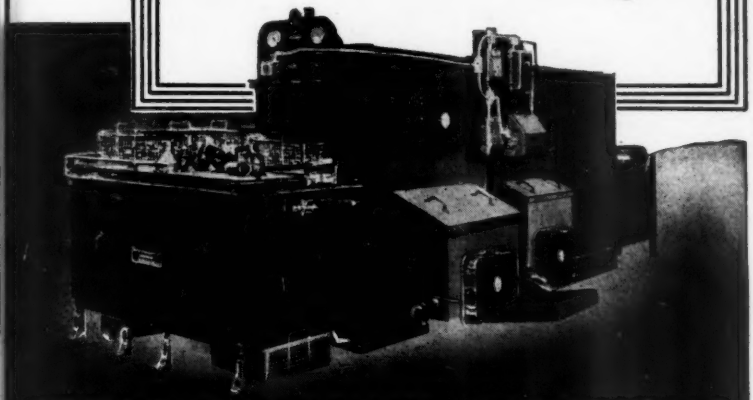

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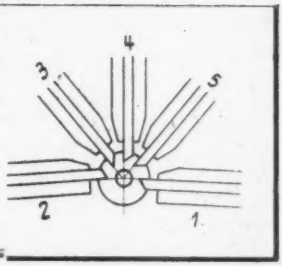

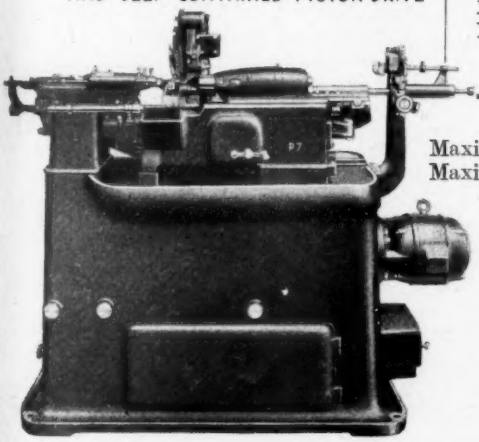

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Maximum turning length 2¾ in.

Distinctive Features:

Sliding Headstock — rigid setting of the five toolholders.

Nitrided headstock spindle, accurately finished and ground.

Can be run at 10,000 r.p.m.

All feed and speed changes made by gears.

Ease of fitting various attachments.

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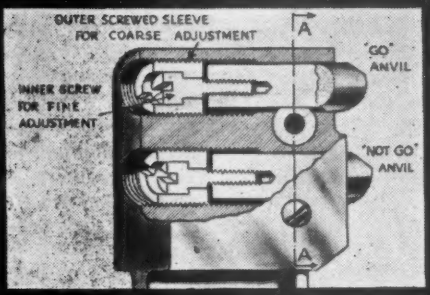
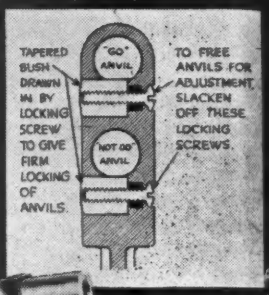
SPECIAL FEATURES OF THE NEWALL ADJUSTABLE EXTERNAL LIMIT GAUGE




TAPERED BUSH DRAWN IN BY LOCKING SCREW TO GIVE FIRM LOCKING OF ANVILS.
"GO" ANVIL
"NOT GO" ANVIL
TO FREE ANVILS FOR ADJUSTMENT, SLACKEN OFF THESE LOCKING SCREWS.

In the design of the Newall Gauge nothing is left to chance. Adjustment of the anvils is positive in both directions and the locking mechanism is quite separate. Simple yet sure methods of adjusting and locking anvils ensure accurate gauging.

DIAGRAMS SHOW METHOD OF ADJUSTING AND LOCKING THE "GO" AND "NOT GO" ANVILS

NOW AVAILABLE EX STOCK AT REDUCED PRICES

STYLE "N" GAUGE SHOWN HERE IS AVAILABLE IN ¼ INCH STEPS UP TO 6 INCHES CAPACITY. STYLE "O" (NOT ILLUSTRATED) IS MADE FROM 6 TO 30 INS. CAPACITY

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As a war-time measure the advertisement section of this Journal is now published in two editions, A and B. Advertisers' announcements only appear in one edition each month, advertisements in edition A alternating with those in edition B the following month. This Index gives the page number and edition in which the advertisements appear for the current month.

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INSTITUTION NOTES

December 1943

Meetings.

16th December—Leicester Section. A lecture will be given at The College of Technology, The Newarke, Leicester, at 7-0 p.m. on "Powder Metallurgy" by S. V. Williams, Esq., B.Sc.

17th December—Lincoln Sub-Section. A lecture will be given at The Technical College Lecture Hall, Lincoln, at 6-30 p.m. on "Modern Machine Tool Manufacture" by T. P. N. Burness, Esq., of Halifax.

19th December—Luton and District Section. A meeting will be held at Luton Library Meeting Room, George Street, Luton, at 10-0 a.m., when three short papers will be read by Luton Members.

1944

3rd January—Coventry Graduate Section. A meeting will be held in the Coventry Technical College (Room A5) at 6-45 p.m. when three short papers will be read: (1) "The Design of Cams for Single Spindle Automatic Machines" by G. A. Bayley, Esq., Grad.I.P.E., (2) "Waste Elimination and Salvage" by D. H. Morgan, Esq., Grad.I.P.E., and (3) "The Relationship between the Production Engineer and the Management" by J. B. Scott, Esq., Int.A.M.I.P.E.

7th January—London Section. A meeting will be held at the Institution of Civil Engineers, Gt. George Street, London, S.W.1, at 7-0 p.m. when W. Hewett, Esq., Grad.I.P.E., will lecture on "Training of Young Engineers."

7th January—Lincoln Sub-Section. An informal discussion on "Inspection" will be held in Messrs. Robey's Canteen, Canwick Road, Lincoln, at 6-30 p.m. The discussion will be opened by A. Johnstone, Esq., M.I.P.E.

7th January—Manchester Section. A meeting will be held at the Mechanics Institute, Crewe, at 7-15 p.m., when R. Appleby, Esq., A.I.P.E., will lecture on "Production Control."

8th January—Yorkshire Section. A meeting will be held at the Hotel Metropole, Leeds, at 2-30 p.m., when R. Appleby, Esq., A.I.P.E., will lecture on "Production Control."

15th January—Nottingham Section. A meeting will be held in Derby, when J. W. Ginever, Esq., will lecture on "Quality Control."

15th January—Yorkshire Graduate Section. A visit to the works of the English Electric Company, Bradford, has been arranged.

22nd January—Yorkshire Graduate Section. A meeting will be held at the Great Northern Hotel, Leeds, at 2-30 p.m. when the following short papers will be read : (1) " Operational Planning," by H. Lister, Esq., Grad.I.P.E., Grad.I.E.E., (2) " One Type of Salvage," by R. W. Marston, Esq., Grad.I.P.E., and (3) " Limit Gauging Methods as applied to Screw Threads," by J. Payne, Esq., Grad.I.P.E.

22nd January—Manchester Section. A meeting will be held at University of Liverpool, Brownlow Hill, Liverpool, at 2-30 p.m., when H. W. J. Inshaw, Esq., will lecture on " The Advantages of Using Plastics."

27th January—Leicester Section. A meeting will be held at the College of Technology, The Newarke, Leicester, at 7-0 p.m., when Dr. G. Schlesinger, Hon.M.I.P.E., and R. E. Reason, Esq., A.R.C.S. will lecture on " Methods and Uses of Surface Finish Measurement." This is a joint meeting with the Leicester Association of Engineers.

27th January—Glasgow Section. A meeting will be held in The Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.2., at 7-15 p.m., when W. Puckey, Esq., M.I.P.E., will lecture on " Management in Action."

28th January—London Graduate Section. A meeting will be held at 36, Portman Square, London, W.1., at 7-0 p.m., when K. J. Hume, Esq., will lecture on " Precision Measurements by Optical Methods."

30th January—Luton Section. A meeting will be held at the Luton Library Meeting Room, George Street, Luton, at 10-0 a.m., when Dr. G. Schlesinger will lecture on " Spindle Bearings."

Committee Meetings.

4th January—Education Committee (Special Meeting), Queen's Hotel, Birmingham, at 11-30 a.m.

5th January—Technical and Publications Committee (at Institution Headquarters), 5-30 p.m.

11th January—Membership Sub-Committee at the Queens Hotel, Birmingham. 10-0 a.m.

12th January—Technical and Publications Committee (at Institution Headquarters) at 5-30 p.m.

16th January—Management Committee of the Research Department at Nottingham, 6-0 p.m. (at the Black Boy Hotel, Nottingham).

17th January—Management Committee of the Research Department at Loughborough, 10-0 a.m.

17th January—Finance Committee of the Research Department at 2-0 p.m.

19th January—Technical and Publications Committee at Headquarters, 5-30 p.m.

21st January—Finance and General Purposes Committee, at Institution Headquarters, 2-15 p.m.

21st January—London Section Committee at Institution Headquarters, 12-0 noon.

25th January—Education Committee at Queens Hotel, Birmingham, 10-0 a.m.,

25th January—Membership Committee at Queens Hotel, Birmingham, 12-30 p.m.

26th January—Technical and Publications Committee, 5-30 p.m.

28th January—Finance and General Purposes Committee (special meeting) at Institution Headquarters, 11-30 a.m.

Wolverhampton Section.

On Tuesday, 30th November, 1943, the inaugural meeting of the Wolverhampton Section was held at the Wulfrun Hall, and was presided over by Mr. E. W. Hancock, M.B.E., who has been elected first President of the Section. The provisional officers and Committee elected were as follows :—

Mr. E. W. Hancock, M.B.E. (President).

Committee : Messrs. J. D. North, H. Bainbridge, W. A. J. Chapman, L. Farrer, H. C. Johnson, A. J. Burns, J. Montgomery.

The meeting was well supported, some 170 members and visitors being present. Among those present were the Mayor of Wolverhampton, Colonel H. B. Sankey, Regional Controller of Production, and Lord Sempill, Deputy President of the Institution.

Halifax.

On Saturday, the 4th December, a preliminary meeting was held at Halifax, to discuss the possibility of forming a Branch of the Institution in this district. The following were elected to serve as a temporary Committee : Messrs. W. P. Eastwood (Chairman), A. Mitchell (Hon. Secretary), A. K. McCall, J. Butler, H. Denham, J. F. Chapman, C. A. E. Vince, H. Nutton, Mr. Blakiston and Mr. Crawley.

At the Council Meeting held on 10th December, permission was given to the Halifax Committee to form a Section.

Loughborough Student Centre.

Members will be interested to know that the Loughborough College Student Centre has resumed its activities by holding the first meeting of the session on the 23rd November, when Mr. Mark H. Taylor gave a lecture on "Some Applications of Optics to Engineering." The provisional Committee elected was as follows :

Dr. H. Schofield, M.B.E. (President), Dr. G. Schlesinger (Vice-President), Mr. P. J. Bannister (Chairman), T. D. Walshaw (Hon. Secretary), D. Taylor (Assist. Hon. Secretary)., Messrs. R. E. Green, J. J. Peck, B. D. Pugh, G. Smith, J. F. Peck.

London Graduate Section.

On Friday, 26th November, at 7-0 p.m. the London Graduate Section held a meeting at Headquarters when Mr. Spragg presented his paper on "Arc Welding as applied to Jigs and Fixtures." to a gathering of some 50 members and visitors.

The speaker opened the paper by stating what progress had been made in the last few years in the fabrication of ships, bridges, tanks, high pressure vessels, gasometers, and commercial vehicles, etc., and Arc Welding had been highly responsible for this advancement, as sheets of mild steel from 20 s.w.g. to 1 in. thick can now be satisfactorily welded. Examples of this type of work was then shown on the screen, and also the various types of portable Arc Welding Plants which can now be obtained.

Mr. Spragg spoke of the best type of jigs to be used for Arc Welding and emphasised how the welding time could be improved, providing the suitable type of welding fixtures were selected.

The meeting was then thrown open for discussion, and Mr. Webster asked the speaker if Arc Wleding reduced to a minimum or deleted altogether any distortion which was liable to take place during normal welding methods. Mr. Spragg pointed out that it was usually advisable to contact the experts in matters where considerable distortion was experienced, so that they could advise a " Welding procedure " to be adopted in order to reduce this to a minimum, naturally each problem would have to be tackled on its own merits.

Mr. Webster then went on to say that he wished there had been more said about Arc Welding as a means to facilitate the manufacture of Jigs and Fixtures and Cutting Tools. Mr. Laws was then called upon to answer this question, and he told us he had had a certain amount of experience with building up the cutting edges with high speed steel on large mild steel milling cutters, and how that in large size press tools the die and punch could be made from mild steel, and a harder material could be welded to the shearing edges, this would naturally have to be ground " flush " afterwards, and a considerable saving was made in the cost of material. This process of welding can also be applied to certain mouldings work where a mild steel moulding die is used first being rough milled to within $^{1}/_{32}$ in. and then lined by means of Arc Welding with a harder material, an finished off in the usual manner. In the case of large moulding dies a considerable saving in material is made. Mr. Laws emphasised that this type of work was still in its infancy, and that he thought it had great prospects.

A general discussion then followed.

The meeting was concluded at 9-45 p.m. by Mr. Shankeshaft passing a vote of thanks for Mr. Spragg.

ORGANISATION AND CONTROL OF PRODUCTION

*Paper presented to the Institution by an Affiliated Firm**

Many years ago man had to depend solely upon his own personal efforts—usually a combination of crafts such as, Hunter, Farmer, Builder, Tailor, etc.,—to ensure his existence, and in addition, he had to be skilled in the use of weapons with which to preserve his life.

Gradually after a very long and painful process which rapidly gained impetus during the past century, a primitive type of industrial organisation was evolved and people settled down to certain conditions and laws ; some sort of division of labour was introduced, and most men adopted a craft or profession to support themselves and their families.

For a very long period, these early craftsmen acted as their own designers, manufacturers and salesmen, their workshops being part of their residences, and all members of the household usually contributed towards some proportion of the productive effort.

The more energetic and enterprising of the successful craftsmen soon found that demand was far in excess of supply, and had to greatly extend their business premises and to employ and train others to work for them. This resulted in an increased number of specialist craftsmen and was the beginning of the Factory System.

The next and most important phase in industry was the introduction of mechanised production by the invention of the steam engine. The hand craftsmen, not able to compete against this form of mechanised power, as such ceased to exist and were forced to adapt themselves to the new methods of production and learn their craft all over again.

As these new methods gradually became stabilized, conditions of living became greatly improved. Production methods were constantly being improved upon, labour was cheap and the supply inexhaustable, and as no difficulty was experienced in selling what was being produced, improvements in design were only put through at the convenience of the proprietor.

* The Associated Equipment Co. Ltd.

About this time, industry received another great impetus by the revolutionary changes that were made in transport. This was mainly attributable to:

1. New methods in road construction, invented by Telford and Macadam, with greatly beneficial effect upon transport and communications.
2. The construction of canals, thus forming a cheap and effective means of transport for manufactured goods and products.
3. The construction of railway systems rendering districts previously difficult of access to be more easily reached, thus affording a speedy and regular movement of products.
4. Construction and use of steamships for coastal and international trade.

During this period, factories were still small enough to be managed effectively under the individual control of one man, the method of control usually being of a very crude nature, but sufficiently effective to meet the needs of the day.

The introduction of electric light and power led to another great change in industrial conditions, and it was during this period that many of the older manufacturing concerns extended far beyond the limits of individual control, and with the assistance of electric power, more efficient machinery and methods of production manufacture was gradually being developed towards what is now called "Mass Production Lines."

Also many new industries became established, particularly in the manufacture of electrical appliances and accessories.

The general effect of all this was the creation of a still higher standard of living—people became more prosperous and articles previously considered luxuries became necessities. This led to a great increase in production, and as the demand was still in excess of production, the need for limitation of production was unnecessary.

This state of industrial prosperity continued until the Great War of 1914—1918, although prior to this period very few business concerns had any definite conception of scientific management. During the period of this conflict the urgent need for munitions of war brought about an extraordinary intensification in methods of production in a measure never before attempted, and it was then that the need of a highly organised system of control was found to be necessary to adequately supply the needs of the fighting services.

Engineering activities extended very rapidly, and, at the same time, became more complicated, and many skilled craftsmen became specialists in the various branches of the industry. With the intensive use of Jigs and Fixtures, it was found possible to produce articles in vast quantities cheaply and with a very high degree of

accuracy and interchangeability, and this led to the formation of a specialist group, whose job it was to design and manufacture Jigs, Tools and Fixtures.

Jig and Tool design required a general knowledge of manufacturing processes, and sequence of operations and plant upon which these operations were to be performed, and these duties were undertaken by another specialist—the Process and Rate-setting Engineer.

To ensure correct interchangeability, a rigid inspection had to be maintained on all components, and this responsibility was undertaken by the Inspection Engineer.

The formation of specialist groups was also extended to technical and clerical staffs—Planning Engineer, Progress Chasers, Material Controllers, etc.

The natural conclusion to this was the appointment of yet another specialist whose job it was to co-ordinate all these factors—the Production Engineer.

The conclusion of the Great War of 1914—1918 was closely followed by a state of industrial chaos, with which we are all only too familiar—industrial conditions had undergone vast changes—production had outstripped demand and was subject to acute fluctuation both in quantity and variety, and the stage was reached when it was found far easier to increase production than to dispose of it. A natural effect of this was the need for constant modifications to the product to meet ever-changing demands and increasing competition.

The need of a highly organised system of production control at once became of vital importance, as owing to a pampered and uncertain market it was necessary to reduce production costs and prevent a creation of excessive stocks which tended to tie up capital which could be more effectively utilised.

The Engineering Industry again became involved in an industrial revolution—of equal importance—although very different from that of the previous century, and many engineering organisations found that they had to once again re-organise their production methods.

Intense efforts were made to improve existing systems of Production Control, and many new and more scientific methods were devised. Organisations previously reluctant to introduce a system of control were forced to realise that without such a system there could be no effective solution to their production problems.

The Production Control Department thus became an important and essential feature in most engineering organisations, and also became firmly established in many other industries.

This brings us to the present stage when we again find ourselves engaged in a deadly conflict with other great foreign powers, and in spite of the highly organised state of industry it has, due to the

magnitude of the conflict and the highly mechanised type of warfare, taken over three years to provide sufficient armaments to enable us to take the offensive.

The Production Control Department has again been called upon to take an important part in the national effort to bring the war to a successful conclusion. The shortage of certain essential materials and skilled labour has made the task of synchronising supplies of material and finished components to meet production requirements a very difficult one. Nevertheless, with full and intensive co-operative effort of every single member within the organisation, the task will be successfully accomplished.

The foregoing is only a very brief survey of industrial conditions leading up to the present time, but will, it is hoped, give some indication of events leading up to the introduction and necessity for highly organised systems of control in industrial organisations to deal effectively with ever increasing production problems.

The system herein described, although not claimed to be the " perfect " system, has been found, by experience, to be a proved method of control and one sufficiently flexible to have obtained good results.

RELATIONSHIP BETWEEN HIGHER EXECUTIVE ADMINISTRATION AND MANUFACTURING DEPARTMENTS WITH PRODUCTION CONTROL DEPARTMENT

The successful operation of any system of Production Control depends very largely upon its relationship with other sections within the organisation and it is essential, therefore, that a clear definition is made of the exact spheres and responsibilities delegated to each department and official before an effective system of control can become operative.

A study of Fig. 1, illustrates the division of such responsibilities necessary to a production organisation and a brief summary of the functions is given below.

HIGHER EXECUTIVE ADMINISTRATION

Chairman and Managing Director.

Responsible to the Board of Directors for the control of the Company. He is assisted by a staff to whom he delegates the control of the various departments governing the activities of the organisation.

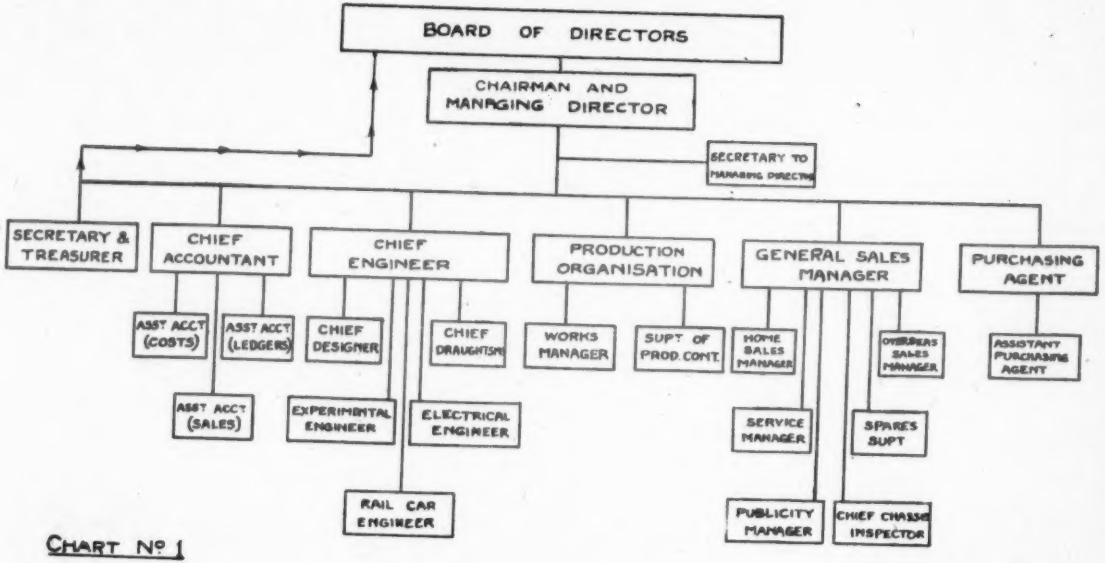


CHART No 1

Fig. 1

Secretary and Treasurer.

Responsible for the usual Secretarial and Financial arrangements of the Company.

Chief Accountant.

Responsible for the usual Accountancy, Costing and Statistical work.

Chief Engineer.

Responsible for Design, Experimental Research and Development in connection with the products of the Company.

General Sales Manager.

Responsible for the Sales and Service (Home and Overseas) activities of the Company.

Purchasing Agent

Responsible for the placing of all contracts and the purchase of all materials required by the Company.

Production Organisation.

Wholly responsible for each and every phase of manufacture under the Works Manager and the Superintendent of Production Control.

PRODUCTION ADMINISTRATION

Reference to Fig. 2, will show the relationship between the Higher Executive and Production Administrations and the respective responsibilities and functions of the Works Manager and the Superintendent of Production Control Department.

Works Manager.

Control of all Productive activities—Manufacturing Departments —Jig and Tool Design and Manufacture—Inspection—Labour Supply—Laboratory—First Aid and Welfare—Fire Brigade and Police Services.

Superintendent of Production Control.

Responsible for Planning all Production Operations, Production Schedules, Process Layouts, Control of Material Supplies, Works Progress, Shop Transport, External Transport, Stores (including Receipt and Issue of all Production Materials), Machine Loads, Issue of Works Instructions.

Fig. 3 illustrates in detail the division of responsibilities within the Production Control Department and as will be seen, the field covered is fairly extensive and each of the many functions of this Department requires expert knowledge in their operation. Each function or

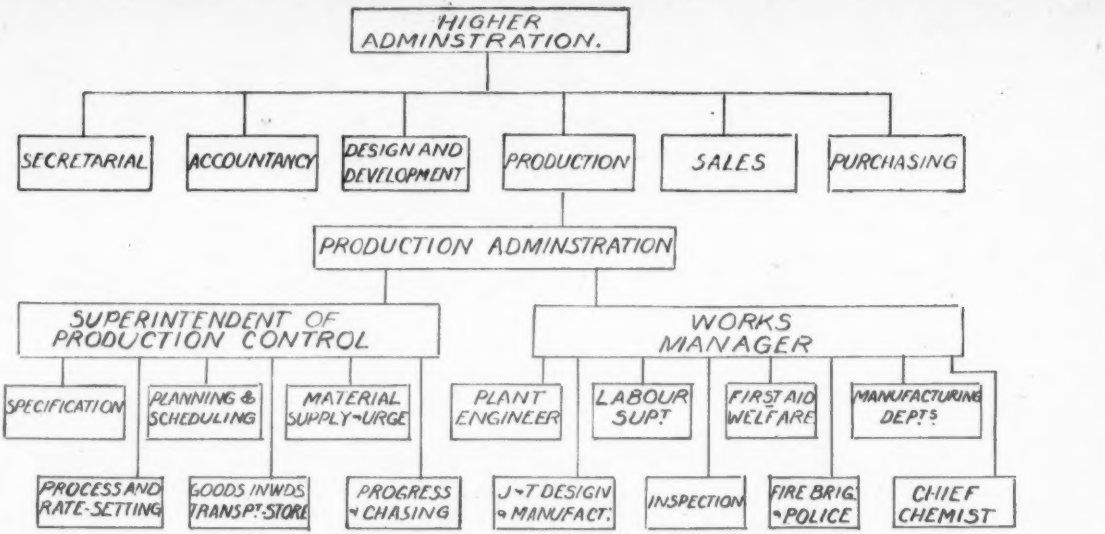
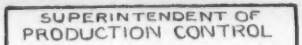


CHART SHOWING RELATIONSHIP OF PRODUCTION CONTROL

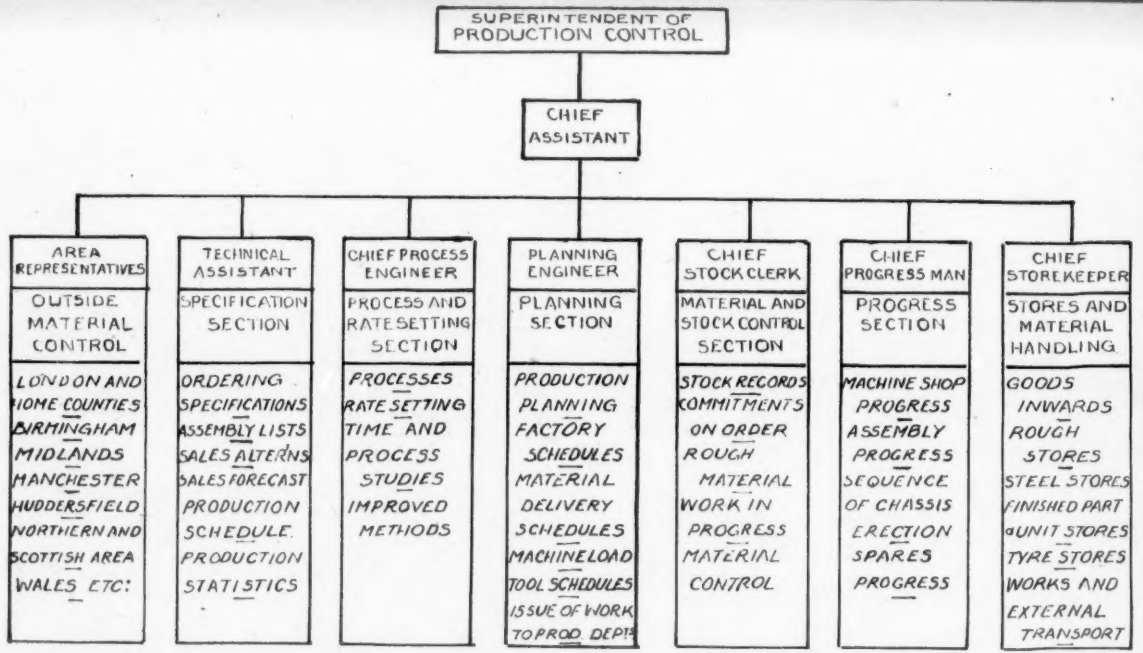
RESPONSIBILITIES TO OTHER DEPARTMENTS

Fig. 2.



RESPONSIBILITIES TO OTHER DEPARTMENTS

Fig. 2.



DIVISION OF RESPONSIBILITIES
WITHIN PRODUCTION CONTROL DEPARTMENT.

CHART No. 3.

Fig. 3.

unit is welded together in such a manner as to form one effective department, every single member of the department co-operating fully and harmoniously, each performing their quota towards the total effort necessary to ensure the successful operation of the system.

PRODUCTION CONTROL

Definition.

Production Control may be defined as a system which co-ordinates the order of movement of all the elements of a production programme in relation to each other, and the whole, and which by accurate pre-planning and control of every movement of productive operations in all stages of manufacture ensures completion of the final product in accordance with pre-determined plans.

Pre-planning demands intimate knowledge of :—

(a) The kind and quantity of materials required for the product.
(b) Period required to obtain raw materials.
(c) Methods of performing manufacturing operations.
(d) Time required for each operation of all component parts.
(e) Productive capacity of Plant and Equipment.

The following factors must also be taken into consideration if an effective system of control is to be maintained.

Analysis of Product.
Control of stocks and material supplies.
Scheduling of work through the Manufacturing Departments.
Control of work in progress.
Transportation of work to the various operations.

Functions.

The principal functions of the Production Control Department may be briefly summarised as follows :—

1. Arrangement and preparation of Specifications and Schedules for production of completely assembled units and chassis.

2. Requisitioning and Controlling Material Supplies for the production of completely assembled units in accordance with Manufacturing Schedules.

3. Receiving—Storing and Handling all Materials and Supplies for production.

4. Control of work in progress throughout the Manufacturing Departments in conformity with Production Schedules.

5. Compilation of Process Layouts and Fixing Standard times for the various machining, fitting and assembly operations necessary to the economic production of component parts.

6. Planning—Construction of Material Schedules—Manufacturing Schedules—Jig and Tool Schedules and compilation of Machine Loads.

The above are the major factors which govern the movements of a production programme and it is essential that the Production Control Department maintain effective control over all these factors before an effective system of control can become operative.

Constitution.

A division of responsibilities thus becomes necessary within the production control organisation to co-ordinate and control these factors, each separate division or section being a specialised unit operating in close co-operation with each other under the supervision of a Section Supervisor with clearly defined responsibilities.

Specification Section.
Material Control Section.
Process and Rate-setting Section.
Planning Section.
Goods Inwards.
Stores (Rough Material, Steel Bar, Sheet Metal, Unit and Finished).
Progress Section.
Works Transport.
External Transport.

Production Control Department Central Office.

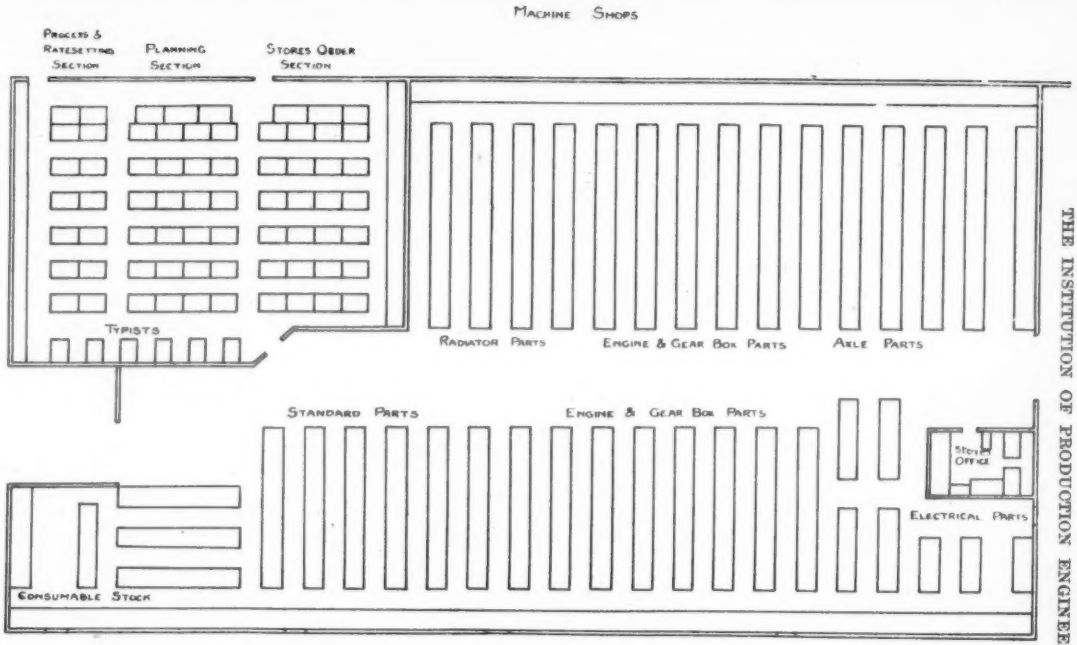
With the exception of the Specification Section, Goods Inwards and Stores, the whole of the Production Control Department staff are accommodated in one Central Office situated in the centre of the Works, readily accessible to the Production Departments and adjacent to the Finished Stores.

As will be seen by the accompanying plan (see Fig. 4), the layout of this office has been arranged to conform as closely as possible with the sequence of the duties for which it is responsible, thus avoiding the necessity of passing various documents, correspondence, etc., backwards and forwards from one Section to another.

Enquiry windows are placed at the end of each Section, in order to eliminate the necessity for a continual stream of visitors through the office, which is strongly discouraged.

The Specification Section, by reason of the necessity for close personal contact and liason with the Purchasing—Cost and Design Departments, is situated in the General Office. The Goods Inwards and Stores Offices are adjacent to their respective activities.

It is interesting to note that most of the desks with which the Production Control Department Central Office is equipped have been specially designed by the Production Control Department and manufactured on the Company's premises.



LAYOUT OF P.C.D CENTRAL OFFICE & FINISHED PART STORES.

FIG. 4.

SPECIFICATION SECTION

Functions.

Compilation of Production Programmes, Compilation of Component Parts Lists and Assembly Lists, Issue of Production Schedules, Issue of Production Instructions to Manufacturing Departments, Production Statistics, Preparation of Material Analysis Statement, Iron and Steel Control Procedure.

Compilation of a Manufacturing Programme.

The activities of the Production Control Department commence with the authorisation of a Manufacturing Programme.

Sanctions.

The Sales Department (after consultation with the Production Control Department) submits an Estimated Sales Programme to the Chairman and Managing Director at a weekly conference and upon approval authority is obtained in the form of a SANCTION incorporating in the Minutes of the meeting. This sanction authorises the Production Control Department to proceed with the requisitioning of material supplies, manufacture of Patterns, Dies, etc.

Programme Symbol.

Upon receipt of the sanction a PROGRAMME SYMBOL is allocated which is endorsed on all documents pertaining to costing and identification purposes throughout manufacture.

Particulars of the sanction in regard to Programme Symbol, Date of Sanction, Quantity involved, Model and Type, and any special features to be incorporated are recorded by Specification Section.

Allocation of Chassis Numbers.

A series of CHASSIS NUMBERS is then allocated, thus providing an indication of the Sanction and Date from which any particular series of chassis emanates.

Production Schedule.

A PRODUCTION SCHEDULE, Form No. PR.1 (see Fig. 5), is prepared giving details of Production Requirements covering a period of approximately six months.

On this Schedule details are given of Type and Description of Chassis and Main Units, Programme and Contract Symbols, and weekly production requirements of each model unit.

Details are also given in regard to Weekly Spares Production requirements.

The Production Schedule forms the basis of all Production Control Department activities in connection with Control of Materials Supplies, Planning and Production.

PRODUCTION SCHEDULE

CHASSIS TYPE	MODEL	PROG.	ENG.	O/S.	MARCH 6	13	20	27	APRIL 3	10	17	24	MAY 1	8	15	22	29	JUNE 5	12	19	26
					10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
6BTX	STANDARD.	WC WQ	6BTXE	2430	35	39	35	39	41	45	36	40	41	35	21	25	21	25	21	25	21
4LVC	COMM: (Heavy)	WW	4LVCE	121							5	5		10		10		10		10	
4LLP	COMM: (Light)	XH	4LLPE	155											10		10		10		10
8PHV	PASS: (D.D.)	WD XA	6BTXE	341	12	12	12	12	12	12	12	12	12	6	12		12		12		12
6PHM	PASS: (S.D.)	XD	6BTXE	149										6		12		12		12	
2CMV	COMM: (Med)	XF	2CMVE	89				NOT	REQUIRED	-	HELD	IN	ABEYANCE								
3CLV	PASS: (D.D.)	WR	6BTXE	423	5	5	5	5							10	10	10	10	10	10	10
8CLL	COMM: (L.L.)	XK	6BTXE	150						COMMENCE	OCTOBER										
	TOTAL CHASSIS	PER WEEK	...	...	52	56	52	56	53	57	53	57	53	57	53	57	53	57	53	57	53

ENGINES TYPE	MODEL	PROG.	O/S	ALLCN.																	
6BTXE	STANDARD.	WQ WC	2675	PROD.	35	39	35	39	41	45	41	45	41	45	31	35	31	35	31	35	31
		XC WU	244	SPARES	6	6	6	6	6	6	6	6	6	6	4	3	4	4	5	4	5
4LVCE	COMM: (Heavy)	WD XA	559	PROD.	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
		XJ	50	SPARES	1	2	1	1	1	2	1	2	1	2	1	2	1	1	1	1	1
4LLPE	COMM: (Light)	WR	408	PROD.	5	5	5	5							10	10	10	10	10	10	10
		WV	125	SPARES	1	1	1	2							2	3	2	3	2	3	2
2CMV	COMM: (Med)	XE	250	PROD.	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
		WF	163	SPARES					1	2	2	2	2	2	2	2	2	2	2	2	2
	TOTAL ENGINES	PER WEEK	...	...	66	71	66	71	67	73	68	73	68	73	68	73	68	73	69	73	69

GEARBOXES TYPE	MODEL	PROG.	O/S	ALLCN.																	
D.142	F.W.D. & S.W.D. AUX.	WC WQ	3279	PROD.	47	51	47	51	53	57	53	57	53	57	43	47	43	47	43	47	43
				SPARES	4	4	4	4	5	5	5	5	5	5	5	4	4	5	4	4	5
D.143	F.W.D. & S.W.D. MAIN	XM XP	3289	PROD.	47	51	47	51	53	57	53	57	53	57	43	47	43	47	43	47	43

PR-1.

Fig. 5

Advice to Manufacturing Departments.

Details of the Sanction are passed to all manufacturing departments and production executives concerned giving full particulars in regard to Programme Symbol, Chassis Model or Type, Quantity involved, Chassis Numbers, brief particulars of Specification, special fitments to be incorporated and Delivery Date and Rate of Chassis Production.

Analysis of Product.

An ANALYSIS of the Product is made from Assembly Drawings and Drawing Office Parts Lists in order to determine:

1. Complete Lists of Component Parts required for the finished product.

2. List of parts comprising various Assemblies and Sub-assemblies.

Component Parts Lists (Schedule "A").

This SCHEDULE, Form No. ST.5604 (see Fig. 6), is a complete register of all component parts (in sequence of part number) used on all Standard Types of Chassis, indicating Part Number, Description, of Component, Quantity per set on each Model, Material Specification and Sizes; a space also being provided for details of Design Alterations.

This Schedule is kept up to date from information passed from the Drawing Office in the form of Alteration Advice Notes.

It is from Schedule "A" that all chassis parts are ordered, a copy of this schedule being retained and kept up to date by the Order Section.

Copies of the Schedule are also passed to the Planning Section for compilation of Machine Load Schedules.

Material Analysis Cards.

From information contained on the parts lists, MATERIAL ANALYSIS CARDS, Form No. MA.1, are prepared for each separate component part.

On these cards information is recorded in regard to Part Number, Description of Component, Description and Specification of Material, Form of Material, Process and Size. Details are also given in regard to whether the component is supplied in a finished or rough condition, weight of component (rough and/or finished), Supplier and Quantity used per unit or chassis.

Reference is made to these records for compilation of statistical data for M.O.S. and adjustments to the component parts lists (Schedule "A").

SHEET Nº A2				Nº PER SET PER EACH MODEL																		MATERIAL LIST		A2
				6 Cylinder																A Cylinder				
PART Nº	DESCRIPTION	A97	A90	A93	A96	A99	A912	A913	A910	A94	A95									A93	A96	A99	MAT.	SPECIAL	DIMENSIONS OF PART IN ROUGH
A1010	CYLINDER BLOCK																			1					
A10122	CYLINDER BLOCK			1						1													CAST IRON	15	CASTING
A1028	CYLINDER BLOCK																			1					
A10135	CYLINDER BLOCK																				1	1	CAST IRON	15	CASTING
A10137	" "	1			1		1			1													CAST IRON	15	CASTING
A10139	CYLINDER BLOCK								1																
A10143	CYLINDER BLOCK		1				1	1															CAST IRON	15	CASTING
A10145	" "										1														
A10412	VALVE - EXHAUST				6							6								4	4	4	ALLOY STEEL	34	
A10417	" - INLET				6							6								4	4		ALLOY STEEL	34	
A10429	" - EXHAUST		6				6	6			6		6										ALLOY STEEL	34	27/32 DIA 13 LONG
A10426	" - INLET		6				6	6															ALLOY STEEL	34	27/32" DIA 13" LONG
A10432	" - EXHAUST	6			6	6			6	6													ALLOY STEEL	34	27/32" DIA 13" LONG
A10441	" - INLET																					4	ALLOY STEEL	34	3" DIA 13"
A10480	" - INLET	6			6	6			6														ALLOY STEEL	34	FORGING 27/32 DIA 13" LONG
A10420	" - INLET																			4					
A10438	" - INLET							6																	
A10483	" - INLET								6																

Fig. 6

Material Analysis Statement.

To enable the M.O.S. or M.A.P. to assess the amount of materials required for the production of chassis and units in accordance with their contracts, and to arrange availability of materials to synchronise with production requirements, a MATERIAL ANALYSIS STATEMENT, Form No. MA.2, is prepared.

This statement is compiled in triplicate from the analysis record cards and contains information regarding the Type and Description of Chassis or Unit, Part Number and Description of Components, class and specification of Material, Form and Dimensions of Material used, Process, Rough and Finished Weight for each component, Quantity off per Set, whether Bought Out Finished, Part Machined or Rough and Supplier concerned.

A complete list of the names and addresses of all suppliers concerned, together with two copies of the statement are sent to the M.O.S., one copy being retained in the Specification Section for reference purposes.

Iron and Steel Control—Authority Symbol Licences.

Upon the receipt of the sanction for the production of chassis or units, advice is passed to the Cost Office in order that they may apply to the Iron and Steel Control for an AUTHORITY SYMBOL LICENCE authorising the purchase or manufacture of the various steels required from sub-contractors for the production of the requisite component parts in accordance with M.O.S. contracts.

Accompanying this application is a statement showing gross weights of the various steels required.

Upon receipt of the Authority Symbol Licence, the Cost Office advise the Specification Section in order that they may endorse on all copies of the Purchase Orders the Licence Symbol and Number.

Copies of the official orders are passed by the Purchasing Agent to the Accounts Department for recording details of steel ordered against the total quantity authorised by the licence.

Alteration Advice Notes.

All modifications and alterations to design are covered by the issue from the Drawing Office of an ALTERATION ADVICE NOTE Form No. ST.05391, in which full details are given of the changes required in regard to Dimensions and Design Modifications, M.D. Minute Number, Type and Description of the Unit affected, D.O. Reference Number, Description and Reason of Change, Details of Parts concerned and Disposal Instruction for Parts superseded are included. Space is also provided for details of the cost involved to bring the alteration into effect.

Copies of the Alteration Advice Note are distributed by the Specification Section to the following sources :—

Stores Order Section for adjustment to record and outstanding orders and recording details of material rendered surplus.

Progress Section for necessary action in regard to Work in Progress.

Process and Rate-setting Section for modification to Process Layouts and Records (together with two sets of Detail Drawings of Component parts affected).

Two copies of the Alteration Note are also passed to the Cost Office for valuation of modification, after insertion by the Specification Section of details of material rendered surplus, as indicated from the Order Section copy which is passed to the Specification Section for this purpose.

When the Surplus Material involved amounts to over £5 in value, the signature of the Managing Director is required at the "M.D." Meeting.

Alterations to Catalogues and Instruction Books are effected from Alteration Advice Notes passed direct to the Catalogue Section by the Drawing Office.

Signatures for receipt of the advance copies are obtained from Production Control Department Supervision concerned, on a small index card which is afterwards filed for reference in the Specification Section.

Assembly and Sub-Assembly Lists.

ASSEMBLY LISTS, Form No. 0548, are compiled in tracing form from Drawing Office Parts Lists and Assembly Drawings and give full details regarding the component parts required to build up an assembled unit, viz., Part Number and Description of Components, Quantity Required per Set, Total Quantity required for Batch Issue and columns are also provided for details of quantity actually issued from Finished Stores. (For example see Fig. 7.)

Space is also provided for Programme Symbol, Total Quantity involved, Date of Issue, Part Number of Assembled Unit and Description, also Assembly Section concerned in the Assembly of the unit.

Copies of these lists are issued in print form to all Assembly Sections concerned for reference purposes, to Stores for Issue of Material to Assembly Sections (as required), to Cost Office for Costing purposes and to the Catalogue Section for compilation of Catalogues and instruction books also to the Spares Department (upon request) for the purpose of issuing material to the Main Factory for assembly of Spares Units.

These Lists are kept up to date from the Drawing Office Alteration Advice Note.

ASSEMBLY. No. of Sheets 1. Sheet No. 1

Order No. Component No. A.1198

Batch. Component Water Pump Cover.

No. of Sets.

Date. Issued to Dept. No. Engine.

PART NO.	DESCRIPTION.	NO. OFF PER SET	TOTAL FOR BATCH	STORES ISSUES	REMARKS.
A.1198	Water Pump Cover.	As under			
A.23856	Body.	1			
A.23879	" Cover.	1			
A2/19439	" " Joint.	1			
A.23932	Spindle.	1			
A.27413	" Gland.	1			
A.24015	" " Vane.	1			
Z1/32057	" " Nut.	1			
Z2/45454	" " Spring.	4			
Z2/44896	" "Dist.Pce.	1			
39-1	Setscrew/Cover	4			
39-9	" " "	2			
138-135	" " Washer	6			

M.4913/0546

Fig. 7

Alterations to Assembly Lists.

During assembly and erection of newly designed chassis or units, it is sometimes found necessary to adjust or modify the Assembly Lists to conform with assembly practice.

All requests for such modifications are passed by the Assembly Supervision to the Specification Section on SHOP REQUEST FOR ALTERATION TO BINDER, Form No. AB.1, giving particulars of Part Number and Description of Components Concerned, Unit Numbers and reason for suggested modifications.

Upon receipt of this form by the Specification Section, details are recorded and the request passed to the Drawing Office for approval, which is received in the form of an Alteration Advice Note issued by the Drawing Office and the Assembly Lists are adjusted accordingly.

Surplus material involved is returned to stores accompanied by a Credit Note issued by the Assembly Foreman, and replacement parts issued where necessary.

The "Shop Request Note" and records are endorsed with the Alteration Note Number and the form filed for reference in the Specification Section.

"X" and "X.U." Lists.

"X" and "X.U." LISTS, Form ST.05182, are a series of Assembly Lists comprising items of an experimental or non-standard character including special requirements for incorporation into chassis at customers request.

These Lists bear the prefix "X" and "X.U." followed by a series of numbers allocated by the Drawing Office by whom they are translated into assembly form from the Sales Alteration Notes and passed to the Specification Section for reconstruction to suit assembly requirements.

In addition to giving particulars of special parts, information is also given of parts displaced by the inclusion of these parts, thus indicating to the Order Clerk the components rendered surplus when ordering.

Sales Alteration Instructions.

SALES ALTERATION INSTRUCTIONS, Form No. 5605, are issued by the Sales Department, preliminary copies being sent to Specification Section, Production Department, Chassis Inspection Department, Drawing Office and Accountants Department.

The Drawing Office issue lists to Specification Section (in print form) showing new parts required and parts rendered surplus. After scrutiny by Specification Section, the lists are passed to the Order Section for necessary action in regard to ordering and adjustment of commitments.

Further copies of this list are issued to the Production Departments (to indicate where the new parts are to be incorporated) together with Chasses Priority Lists.

A monthly list is issued by the Cost Office showing the value of material rendered surplus on Sales Alteration Notes, and a record is made in the M.D. Minutes.

Reference Sheets.

REFERENCE SHEETS, Form No. M.1052, are compiled by the Specification Section from advance information contained in the Sales Alteration Note and indicate special details required for incorporation into chassis, parts displaced by the inclusion of special details, chassis number and customer.

Where full details are available, advance copies of the Reference Sheet are immed ately sent to Order and Progress Sections for respective action.

In cases where information is not to hand, the Drawing Office are immediately notified and details included on the Weekly Report submitted to the Drawing Office of items awaiting their attention.

Further copies are issued later in conjunction with Chassis Priority Lists to Chief Storekeeper, (for issue of Special Details) and Assembly Foreman concerned (for incorporation in the Assembly of respective units).

For reference purposes, each list is numbered consecutively and also bears the Sales Alteration Note Number.

Chassis Priority Lists.

CHASSIS PRIORITY LISTS, Form No. CP.1., are issued in conjunction with the Sales Department from customers' delivery requests or Sales demands, showing civilian requirements for the ensuing two weeks.

Information is given on these lists of the Chassis Number and Type, Customer, Engine Bore, Differential Ratio, Sales Note Reference Number and the week in which the chassis are to be built.

Copies of this list are distributed to the Production Superintendent, Assembly Supervision, Electrical Superintendent, Sales Department, Drawing Office, Spares Department, View Room Superintendent and all Sections of the Production Control Department concerned.

Weekly Report—Progress of Production.

A WEEKLY REPORT, Form WPR.1., is compiled by the Specification Section showing the progress of Main Production Programmes. This Report contains details of each Production Programme in regard to quantities Ordered and Outstanding, Delivery Position, Location of Chassis Float and brief comments regarding future production.

Details are also given of serious items governing production and the position thereof.

Copies of this Report are circulated to the Chairman and Managing Director and all Production Executives and Supervision for information and action. A copy is also passed to the M.O.S. for necessary action in regard to material which is in short supply.

Routine Dealing with New Dies for Stampings and Die Castings.

In cases where New Dies are required for Stampings or Die Castings three prints of the part to be fabricated are forwarded to the Supplier for his recommendations in regard to the formation in which he proposes to supply the component.

This is received in the form of the original drawings returned from the Supplier outlined in red or black showing the proposed Die formation.

In order that full advantage may be taken of various view points, these prints are passed to the Jig and Tool Department, Production Department and Process and Rate-setting Section together with the relative correspondence.

Agreement having been reached, one print, together with a letter of instruction, is then returned to the Supplier via the Purchasing Agent, the second copy of the print being retained by the Specification Section and filed with relative correspondence, and the third copy retained by the Inspection Department.

For reference purposes a small INDEX CARD, Form No. M.1087, is kept in the Specification Section bearing the date and signature of the above supervision as an acknowledgment that the matter has received their consideration.

Procedure Dealing with Provision of Patterns.

When ordering Castings necessitating the provision of New Patterns, the Purchasing Agent encloses with the Order two prints of the components concerned, one of which is returned by the Supplier duly marked up with his proposals in regard to production of Pattern.

A copy of the Order is passed by the Purchasing agent to the Specification Section who ensure that no undue delay occurs in the return of the " outlined " drawing by the Supplier.

A REQUEST FOR DESPATCH NOTE, Form No. M.0602, is also issued by the Purchasing Agent, copies of which are passed to Pattern shop and Production Control Department.

On this form details are given of Supplier, Part Number and Description of Component, Programme Symbol, Quantity to be produced, and Order Number.

This note authorises the Pattern Shop Foreman to despatch Pattern to Supplier concerned, or if an alternative supplier, for Production Control Department to arrange transfer to new source of supply.

If the Pattern is to be made at Southall, the Specification Section issue a PATTERN ORDER, Form No. M.4012, which, together with the "outlined" print, is passed to the Process and Rate-setting Section for Job Time to be endorsed and to the Cost Office for approval in regard to cost allocation, thence to the Pattern Shop authorising the manufacture of the necessary Pattern.

Contact is maintained between the Specification Section, Orders Section and Pattern Shop during manufacture to ensure that work is proceeding in accordance with scheduled requirements, and a weekly statement is compiled by the Specification Section and passed to the Pattern Shop indicating the priority sequence in which the pattern is to be manufactured.

Upon completion, the pattern is passed to the Goods Outward for despatch to the Supplier concerned, and the Request for Despatch Note returned to the Specification Section duly signed by the Pattern. Shop Foreman as an indication that the pattern is ready for despatch

In cases where the pattern is to be provided by the supplier, the outlined print is passed direct to the Pattern Shop for scrutiny and is then filed for reference.

When Design Changes necessitate modification to Pattern, a copy of the revised drawing is sent by the Order Section to the Supplier concerned, but if the Pattern is at Southall a request is passed to the Specification Section for the issue of a Pattern Order covering the necessary work.

Repairs to Pattern, if at Foundry, are undertaken by the Supplier concerned, and if at Southall are undertaken by the Pattern Shop, for which a Pattern Order is issued.

Works Orders.

A series of WORKS ORDERS, Form No. 4022, are issued by the Specification Section for all additional work in connection with Sales or Design Alterations.

These orders are endorsed with the cost allocation chargeable to origin of alteration and after be ingsigned by the Assistant Accountant (Costs) and S.P.C. are passed to the Process and Rate-setting Section for Time Limits to be fixed, thence to the Production Department concerned. One copy is sent to Cost Office and a third retained by the Production Control Department for reference purposes.

Spares Order Routine.

All ORDERS received from the L.P.T.B. and Spares Department are scrutinised by the Specification Section and particulars recorded of Part Number, Description, Order Number and Date Received. In in the case of L.P.T.B. Orders, these are passed to the Spares Department so that any surplus stocks which may be available are absorbed and Spares requirements ordered at the same time. The Orders are then passed to the Main Stores Office for necessary action by the Order Section, Process and Rate-setting Section and Progress Section.

ORDER AND URGE SECTION

Functions.

Requisitioning and Controlling Material Supplies for Production, Recording Details relating to Requirements, Orders, Movements of Materials Snd stocks, Control of Material rendered Surplus or Redundant, Internal Stores Audit.

Effective control of material supplies is of vital importance to pre-planned production programmes, particularly when there is a dependency for supplies from outside sources.

Failure to maintain regular supplies is usually followed by serious consequences, as, when material supplies arrive too far ahead of schedule, an undue amount of capital is " tied up " ; on the other hand, if supplies are behind schedule, a still more undesirable state of affairs exists, resulting in a definite hold up in the Works which can rarely be recovered without considerable confusion. Either of these circumstances involves heavy financial loss.

Another important factor which emerges is that unduly large stocks entail much longer periods before improvements in design can be introduced, also much valuable floor space is taken up for storage purposes.

The degree of accuracy with which Stock Records are maintained is another important factor in a system of control. Every movement of material must be accurately recorded so that the complete history of each component can be readily ascertained at a glance on a central record card without reference to numerous other documents.

These functions are the responsibility of the Order and Urge Section under the supervision of a Chief Clerk.

This section is divided into Sub-sections, to each of which certain Unit Assemblies are allocated as follows :—

Section No. 1—Engine (A) and Starting Handle (H) Assemblies.
Section No. 2—Pedal (C), Gear Box (D), Change Speed (E), Clutch (J), Cardan (K), Radiator (N), and Control (R) Assemblies.

Section No. 3—Rear Axle (F), Brake (G), Front Axle (L), Steering (M), Frame (Y) Assemblies.
Section No. 4—Bonnet (P), Dashboard (Q), Petrol Tank (S), Silencer (T), Lighting (V) Assemblies.
Section No. 5—Miscellaneous (Z).
Section No. 6—General Stock (dash numbers).
Section No. 7—" Consumable " Stores.
Section No. 8—Electrical Stores.
Section No. 9—Steel Stores.

A Senior Clerk is in charge of each sub-section under whose supervision is a Material Control Clerk and a small staff of Stock control clerks.

The Senior Clerk is held responsible for all procedure in regard to the Unit Assemblies allocated to his Section and under his supervision, the Material Control Clerk for maintenance of Material Supplies and the Stock Control Clerks for accurately recording all movements of materials on the Master Record Cards.

The MASTER RECORD CARD, Form No. ST.40551 (See Fig. 8 and 9), is a central record on which are recorded details of the component in regard to the Part Number, Description, Material Specification from which it is made, Material and Machining Priorities, Economic Batch Quantities, Alternative Part Number and Production Department concerned in first operation.

Details are also recorded of all Chassis or Engine Types on which Component is used, Quantity used per Set, Purchasing Requisition and Order Numbers and Dates Issued, Quantity on Order, Supplier, Details of Work in Progress and particulars of Receipts and Issues of Material. Space is also provided for details of Shortages and Particulars of Design Changes, Production and Spares Requirements, Stock Balances and Quantity Outstanding to Assembly.

A separate record is kept on a similar MASTER RECORD CARD, Form No. ST.40553 (Green), of all " Bought Out " items. This record is identical in every respect except that the " Work in Progress " and " Rough Material " columns have been eliminated.

Recording " Requirement " Details.

Upon receipt of authority to proceed with a manufacturing programme, an " Ormig " instruction is issued by Specification Section giving details of Chassis Types and Numbers, Pogramme Symbol, Quantity, Delivery Instructions and a brief summary of the chassis specification including special fitments.

Copies of this Instruction are passed by the Chief Clerk to each Section Supervisor who, by reference to the Chassis Components Parts List (Schedule "A"), ascertains the component parts involved and the total requirements of each component part. Details of

MASTER RECORD CARD

A17272 — Part Number
CRANKCASE BOTTOM HALF — Description
No 15 or 17 CASTING — Material
A17272 — Part Number
Alternative Part A17269 ALUM.
Shortages: WQ 26
D.O. ALT. No. 78266 3-48 — DATE — INSTRUCTION: PATTERN ALTERATION USE UP STOCK UNALTERED
INVENTORY CARD No. A50663
THIS CARD ORIGINATED 24.4.48 (DATE) — CARD No. 4
ECONOMIC BATCH 40
MACHINE BAT 1/4
1st OPERATION S.B. VMG
MACHINING PRIORITY 3
MATERIAL PRIORITY 6

REQUIREMENTS

SPARES

O/N	DATE	QTY.	DEL.
15131	24/4	50 47	MAY
15896	29/5	100	SEPT

L.P.T.B.

O/N	DATE	QTY.	DEL.
V 14359	24/5	200	SEPT

PROGRAMME

STN.	QTY.
WQ	1960 1000
WJ	110
XM	500
XP	500
XQ	500
XW	700

TOTAL OUT STANDING TO ASSEMBLY: 3386 / 3360 / 3810

WORK IN PROGRESS

BATCH SYMBOL	MTL. DWN.	QTY.	BALANCE
WQ 15/17	11-4-48	46	
WQ 16/18	26-4-48	40	20 1
WQ 17/19	28-4-48	40	40
WQ 18/20	30-4-48	40	40
WQ 19/21		40	

ROUGH MATERIAL

DATE	IN/OUT No.	ORDER No.	RECEIVED	ISS.	STOCK BALANCE
			Rej. O.K.		
24/4	BROUGHT FORWARD				407
24/4	WQ	16/18		40	367
29/4	743856	74749	44		411
4/5	WQ	17/19		40	371
6/5	743621	64360	9		380
7/5	743621	64360	2		378
7/5	WQ	18/20		40	338
18/5	743788	74749	26		364

FINISHED MATERIAL

DATE	IN/OUT No.	ORDER No.	RECEIVED	ISSUED	STOCK BALANCE
			Rej. O.K.	PROG. OTHER	
24/4	BROUGHT FORWARD				NIL
29/4	40447	WQ 15/17	40		40
1/5	22498	WQ		26	14
3/5	40476	WQ 17/19	20		34
5/5	40477	WQ 18/20	19		53
5/5	22560	WQ		50	3
5/5	B2660	SPARES		3	NIL

Fig. 8

PURCHASING ORDER DETAILS

DATE	REQ. No.	ORDER No.	SUPPLIER	QUANTITY

TOTAL OUT STANDING TO ASSEMBLY

WORK IN PROGRESS

BATCH SYMBOL	MTL. DWN.	QTY.	BALANCE

ROUGH MATERIAL

DATE	IN/OUT No.	ORDER No.	RECEIVED	ISS.	STOCK BALANCE

FINISHED MATERIAL

DATE	IN/OUT No.	ORDER No.	RECEIVED	ISSUED	STOCK BALANCE

Fig. 8

PURCHASING ORDER DETAILS					TOTAL OUT-STANDING TO ASSEMBLY	WORK IN PROGRESS				ROUGH MATERIAL						FINISHED MATERIAL							
DATE	REQ. No.	ORDER No.	SUPPLIER	QUANTITY		BATCH SYMBOL	MTL DWN	QTY.	BALANCE	DATE	IN/OUT No.	ORDER No.	RECEIVED REJ.	RECEIVED O.K.	ISS.	STOCK BALANCE	DATE	IN/OUT No.	ORDER No.	RECEIVED REJ.	RECEIVED O.K.	ISSUED PROG.	ISSUED OTHER	STOCK BALANCE
18-4-48	69827	21/3 64360	BILSTON FOUNDRY	385 376 378																			
28-4-48	69827	1/4 74749	CROWN FOUNDRY	688 603 588																			
8-4-48	69921	13/4 84999	CONEYGRE FOUNDRY	300 350																			
"	"	14 84998	BILSTON FOUNDRY	700																			
"	"	14 84997	CROWN FOUNDRY	700																			

Fig. 9

Programme Symbol and Quantity are entered on the Master Record Card in the appropriate columns under the heading "Requirements."

The Master Record Cards are next subjected to a scrutiny in order to determine the actual quantity of each component to be ordered after making due allowance in regard to existing stock surplus and commitments.

Contact is also made with Spares Stores to ensure that surplus stocks which may be available and Spares Requirements may be absorbed or ordered at the same time. (This procedure is only adopted when civilian vehicles are being ordered—Spares for War Office are ordered on instruction from the Chief Ordnance Officer, Chilwell, via the Spares Superintendent).

NEW COMPONENT PARTS

When a newly designed component is released from the Drawing office for production, the Order and Urge Section issue a PRODUCTION RELEASE FORM, No. M.1049 (Fig. 10) giving details of Part Number and Description of Component, Date of Origin, Model, Programme, Initial Quantity to be manufactured and Description of Material. Information is also given by the Order and Urge Section of the date on which the initial quantity is required finished, also the estimated date on which rough material will be available.

Copies of the Production Release Note are passed to the Jig and Tool Department (for Design and Manufacture of Tooling equipment), Process and Ratesetting Section (for preparation of Time Study and Process Layout) and Planning Section (for compilation of Planning Studies, etc.).

Requisitioning Material Supplies.

Having ascertained the total requirements, a PURCHASE REQUISITION, Form No. ST.8897, is issued stating the Part Number, Description of Component, Programme Symbol, Quantity to be ordered, whether to be ordered in Rough or Finished state and tentative delivery instructions.

Details of Requisition Number, Date of Issue and Quantity are entered on the Master Record Card in the appropriate columns under the heading "Order Details" and the purchase requisition is passed to the Purchasing Agent via Laboratory (for confirmation of Material Specification).

Upon receipt of a satisfactory quotation, the Purchasing Agent issues a PURCHASE ORDER, Form No. 0612, on the Supplier, a copy of which is passed to the Material Control Section and particulars in regard to the Supplier, Order Number and Date of Issue are entered on the Master Record Card in the respective columns under the

heading of "Order Details," the copy of official order being filed by the Material Control Section for reference.

Sheet Metal.

The requisitioning of Sheet Metal is centralised in one Card Clerk and all requests for items fabricated from this class of material from other Sections are passed to him for this purpose.

This material is requisitioned by the Purchasing Agent on the usual Purchase Requisition Form, giving particulars of the Part Number, Description and Size of the Sheet Metal, Quantity and the Programme Symbol for which it is required. The Purchase Requisition is then passed to the Laboratory for checking material specification and from thence to the Purchasing Agent, by whom an official order is subsequently placed on the supplier.

Details of Purchase Order are recorded on the Master Record Cards (Green) specially maintained for this purpose, also receipts from outside suppliers and issues to Production Departments.

In certain cases where there is a steady demand, a maximum and minimum stock is kept of this class of material in order that the Purchasing Agent may purchase economically.

Non-Ferrous Metals (Round, Hexagon, Square and Cored Stick.

This class of material is also centralised in one clerk to whom all requests are passed (in writing) from other Sections.

Purchase Requisitions are issued to Purchasing Agent (via Laboratory) covering requirements as occasion demands, and all movements (Receipts and Issues) are recorded on the Master Record Card (ST.40551).

Steel Bar and Tube.

This material is requisitioned by each Order Clerk in the form of a PRELIMINARY REQUISITION, Form No. M.1034, giving details in regard to Programme Symbol, Quantity, Part Number of Component, Material Specification, Part Number and Dimensions of Material, also delivery requirements.

The preliminary requisition is passed via Laboratory (for confirmation of Material Specification) to the Order Clerk Controlling Steel supplies, who, after recording details on COMMITMENT RECORD CARD, M.1073, and referring to STOCK RECORD CARD, M.1073a, to ascertain existing stocks and commitments, passes a Material Requisition to the Purchasing Agent (via Laboratory) covering requirements.

Details are recorded on the Stock Card in regard to Part Number, Specification and Size of Material, Weight per Foot, Maximum and Minimum Stock, Consumption, also Order Details (Supplier, Order

PRODUCTION RELEASE.

Description: Driving Shaft.

Part No: F 15270

Date of Origin: 7-3-41

Released for Model: 0853 Prod./S.A./Special Contract: V.E. 1st Quantity: 120

Material: No 14A Forging

(Sig.) Order Section →

1st Quantity required finished: July (date)

Rough Material available (est.): June (date)

(Sig.) Machine Loading & Planning Section →

Economic Batch Size

Machine Priority

(Sig.) Jig & Tool Dept →

TOOLS AVAILABLE (date)

MASTER COPY: To Process & Rate-setting → To M/c Loading & Planning → To Jig & Tool Dept → To Process & Rate-setting (File)

BUFF to Process & Ratesetting GREEN Jig & Tool Advance Copy – thence Cost Office.

Fig. 10

Number, Quantity on order and Date), particulars of receipts and Issues of Material and Stock Balance. Material is issued on presentation of Material Kequisition in accordance with normal procedure.

Petrol, Oil, Grease, Etc.

This class of material is personally supervised by the Chief Order Clerk. In the case of Petrol and Fuel Oil a daily check is kept to ensure that all Storage Tanks are filled to maximum capacity, and is requisitioned on the Purchasing Agent covering a period of two months, but in the case of Oxygen and Acetylene the period covered by the material requisition is twelve months. All details of these transactions are recorded on the Master Record Card (Green).

All other material in this category is ordered on a maximum and minimum stock basis as required.

Maintenance Material.

All classes of material under this category such as Brushes, Pails, Soaps, etc., are ordered on a maximum and minimum basis as required, and details recorded on Green Master Record Card.

RECORDING MOVEMENTS OF ROUGH MATERIAL

All movements of Rough Material are recorded on the Master Record Card and Details of Receipt, Rejection or Scrap, and issue of Rough Material are entered under the heading of " Rough Material."

Receipt of Material.

When the Material has been received, information is recorded from a copy of the Goods Received Note, Form No. 02893/5/40, in the respective columns giving the Date Received, Goods Received, Note Number, Suppliers Order Number and Quantity. The quantity outstanding against the Suppliers Order is reduced in accordance with the quantity delivered (Column 5, "Purchasing Order Details ") and added to Stock Balance (Column 7, " Rough Material ").

Rejected Material.

Particulars of Material which has been rejected or scrapped will be recorded in RED INK (Columns 1, 2, 3, and 4) from copy of Reject Note quoting Date, Reject Note Number, Suppliers Order Number and Quantity Rejected.

In cases where material has been rejected *before* issue to Shops, a Reject Note Number will be stated on the Reject Letter and the quantity shown in the Stock Balance Column (Column 7) will be reduced accordingly.

When Rejected Material is not required for replacement, the Reject Note is endorsed accordingly and credit obtained from the Supplier

Issue of Rough Material.

The issue of Rough Material is controlled by the dates indicated on the Factory Schedule. This Schedule is compiled by the Planning Section and a copy passed to the Order and Urge Section for the issue of MATERIAL REQUISITIONS (Notice of Issue, Form No. M. 02601 (see Fig. 11).

The material requisitions are issued by the Order and Urge Section three weeks prior to the date on which material is due for issue to the Production Departments in accordance with the Factory Schedule, and on this form details are given of Part Number and Description of Component, Material from which it is made, Programme or Spares Symbol, Batch Quantity and Batch Symbol (indicated by the Week Number of starting and finishing dates) also Production Department to which the material is to be issued.

Space is also provided for Weight, Allocation and details regarding Date and Quantity issued, also for Signature of person issuing and receiving the material.

The Material Requisition is passed to the Planning Section for release to the Rough Stores (via progress) one week before the date on which the first operation is due to commence as indicated on the Factory Schedule.

When the material has been issued from the Rough Stores, the Material Requisition is returned to the Order Section and details recorded on the Master Record Card in Columns 1, 3 and 6 of Date of Issue, Batch Number and Quantity Issued. The quantity issued is deducted from the quantity shown in stock, leaving a stock balance (Column 7).

If the Material is not available, the Material Requisition is endorsed accordingly by the Order Clerk and passed to the Planning Section for the issue of the Job Card, from whence it is returned to the Material Control Clerk and retained by him pending receipt of material.

RECORDING DETAILS OF WORK IN PROGRESS

Issue of Material from Rough Stores.

When a batch of material is issued from the Rough Stores on a Material Requisition, the corresponding Batch in the "Work in Progress" column is endorsed with the date of issue, indicating that the material for that particular batch has been issued (Column 2, Work in Progress) and the Stock Balance shown in column 4 is adjusted accordingly.

NOTICE OF ISSUE.

DATE ISSUED	SERIES	BATCH	PART NO.

QUANTITY	DESCRIPTION

MADE FROM

ALLOCATION

Assigned _____

Proj. _____

A.E.C. _____

L.P.T.B. _____

ISSUE OF MATERIAL

Date _____

Qty. _____

Iss. by _____

Recd. by _____

M/c LINE or SECTION LAB. SIG:

WEIGHT EACH				TOTAL WEIGHT			
£	s	d		£	s	d	
PRICE	:	:		PRICE	:	:	

MATERIAL REQUISITION

DATE ISSUED	SERIES	BATCH	PART NO.

QUANTITY	DESCRIPTION

MADE FROM

ALLOCATION

Assigned _____

Proj. _____

A.E.C. _____

L.P.T.B. _____

ISSUE OF MATERIAL

Date _____

Qty. _____

Iss. by _____

Recd. by _____

M/c LINE or SECTION LAB. SIG:

WEIGHT EACH				TOTAL WEIGHT			
£	s	d		£	s	d	
PRICE	:	:		PRICE	:	:	

Fig. 11

Receipt of Material From the Factory.

Upon receipt of a batch of completed parts from the Factory the PASS FORWARD SLIP, Form No. 30191, is passed to the Order Clerk via the Finished stores and the Quantity Outstanding against that particular batch (Column 3) is adjusted and the Stock Balance figure shown in Column 4 reduced accordingly.

All Pass Forward Slips are passed to the Order Clerk concerned to ensure that the proportionate amount of material is allocated correctly to Production or Spares Requirements, as indicated on the Factory Schedule.

Rejection of Material from the Factory.

Details of Material Rejected or Scrapped in the Factory, after machining, are obtained from the DAILY VIEW REPORT, Form No. 3701, and recorded in red ink. The quantity outstanding against the batch is reduced accordingly.

RECORDING MOVEMENTS OF FINISHED (B.O.) MATERIAL

All details regarding Receipt, Rejection, Scrap and Issue of Finished Material are recorded on the Green Master Record Card under the heading " Finished Material " as also will be shown the Stock Balance of same (Form No. ST.40553).

Receipt of Material from Supplier.

Upon receipt of Finished Material in Stores, particulars are recorded from the White Goods Received Note (Form No. 02993/5/40) of date and Number of the Goods Received Note, suppliers Order Number and Quantity Received, in columns 1, 2, 3 and 5 respectively.

The quantity shown in the Stock Balance Column (Column 8) is increased accordingly and the quantity outstanding against the Supplier's Order Number (Column 5, " Purchasing Order Details ") is reduced in accordance with the quantity delivered.

Rejected Material.

In the case of Rejection or Scrap of Finished Material from Outside Suppliers, the same procedure is followed as when dealing with rejection of Rrough Material, i.e., particulars being recorded in red ink from the Reject Letter, in columns 1, 2 and 3.

RECORDING ISSUE OF MATERIAL TO ASSEMBLY

All issues of Programme Material to the Assembly Departments are recorded from Assembly Sheets passed to the Order Section from the Finished Stores after the material has been issued from stock.

The Quantity Issued is already indicated against each item by the Storekeeper on the Assembly Sheets.

This information is entered in columns 1, 2, 3 and 6 respectively under the heading " Finished Material " and will include Date of Issue, Unit Number, Programme Symbol and Quantity Issued.

The Quantity Issued is then deducted from the Stock Balance Figure (Column 8) and the Assembly Sheets filed for reference.

Subsequent Issues.

In cases where insufficient material is available from Finished Stock to cover the quantity required on the Assembly Sheets, furthe issues are recorded upon receipt of the material into stores, from " PAID OFF TO-DAY " sheets, Form No. M.1028 (See Fig. 12), which are handed in from Finished Stores daily, and the quantity shown as " Shortage " reduced accordingly.

As an additional check, the Goods Received Note is also endorsed by the Storekeeper with the Quantity and Programme Symbol to which he has allocated the components.

RECORDING DELIVERY OF MATERIAL TO SPARES

Delivery of Material to Spares (A.E.C. and L.T.) is recorded from the Advice Notes which are passed to the Order Section via the Stores upon despatch of the material. Details of Advice Note Number, Date and Quantity Despatched also Order Number are recorded on the Master Record Card in columns 2, 1, 7 and 3 respectively, under the heading " Finished Material " and the Stock Balance figure shown in Column 8 is reduced accordingly.

Material must not be despatched to Spares or L.T. without reference to the Order Clerk concerned for verification that the material for despatch is in accordance with the Spares or L.T. Orders outstanding.

Alterations to Design.

Notification of Modification or Alteration to Design is passed to the Order Section by the issue of an Alteration Advice Note in which full details are given of the changes required, unit affected, components concerned, date the Alteration is required to come into effect, also disposal instructions for parts displaced. Details of the Alteration Note in regard to Alteration Note Number and Date of Issue, also brief details of the Alteration are recorded on the Master Record Card in the space provided.

In cases where components of completely new design are concerned, Suppliers are circularised to determine the position of Outstanding Commitments of the Parts displaced and to effect cancel-

No. 1225

THE ASSOCIATED EQUIPMENT CO. LTD.

PAIL OFF TODAY.

SECTION. ENGINE DATE 20.6.43.

TO ORDER SECTION.

The following material has been issued to Assembly Shops on the undermentioned programmes.

Part No.	Description.	Qty. Iss'd	Allocation. Prog.	Allocation. Qty. Sets	Assem. Sht. or Unit No.	Rec'd by.
A4/11535	Piston	132	XM	150	A3/5516	BRC
A3/11691	Piston Ring	483	XM	150	A3/5516	CdC
A3/11687	Piston Ring	132	XM	150	A3/5516	LHS
A.11727	Gudgeon Pin	150	XM	150	A3/5516	SC
A.12146	Bearing	400	WR	100	A1/5615	KA
A.12315	Bolt	190	XH	80	A3/5618	BKC.
A.44416	Bush	89	XM	150	A2/4663	CdC
M.1028 1/38.						

Fig. 12

lation of outstanding material where necessary.

A Production Release Note is issued for all newly designed parts and arrangements made by the Order Section for the provision of new Patterns where necessary.

A Purchase Requisition is issued endorsed with the Alteration Note Number, Programme Symbol and approximate date upon which initial supplies are required and passed to the Purchasing Agent in accordance with normal procedure.

The Alteration Advice Note is endorsed with particulars of material rendered surplus and returned to the Specification Section for recording the information on the Cost Office copy, for valuation of cost of the alteration.

Surplus Material.

The creation of Surplus Material can generally be attributed to any of the following causes :—

1. Design Changes.
2. Standard Parts displaced by fitment to chassis of Customer's special requirements.
3. Parts produced in excess of Production Requirements.
4. Parts ordered on Suppliers in quantities controlled by economic Purchase Price.
5. Material rendered surplus upon completion of a Production Programme.

1. *Design Changes.* Material rendered surplus due to Design or Modification is disposed of in accordance with instructions contained on the Alteration Note, Material which cannot be absorbed in current production is passed to the Spares Stores on Delivery (M.8842, " R.M.") Notes or, alternatively, is withdrawn from Stores and scrapped. Notification of alterations affecting Work in Progress is passed via the Progress Section to all Machine Lines for the stoppage of all work on the parts concerned and for the withdrawal of all material from the Production Departments and is handed to the Stores Auditor for disposal. The Central Time Office is also notified in order that no further Work Tickets may be issued for that particular job.

2. *Sales Alterations.* (Parts displaced by Customer's Special Requirements). In cases where it is not possible to absorb into current production, the material is passed to the Spares Stores accompanied by a Delivery (M.8842a) ("A") Note. A list is compiled by the Spares Department periodically and passed to the Order Section in order that such parts may be absorbed into production when circumstances permit.

3. *Parts Produced in Excess of Production Requirements.* This material is retained for future possible Programme or Spares Requirements.

4. *Surplus Created by Economic Purchase Price.* The same procedure is adopted as in " 3 " above.

5. *Material Rendered Surplus upon Completion of a Production Programme.* On completion of Annual Stocktaking, a list of all Surplus material is compiled by the Order Section and submitted to the Chief Accountant for agreement in regard to disposal. Current material may be retained and absorbed in future Production Programmes or, alternatively, sent to the Spares Surplus Stores at the discretion of the Chief Accountant.

Surplus Material, Excess Deliveries.

In cases where material is delivered by Outside Suppliers in excess of actual requirements, the Accounts Department is at once notified and the supplier informed that payment will be withheld until such time as the excess has been absorbed.

Obsolete and Redundant Material.

Where the Drawing Office propose to effect alterations on items involving large sums of money, a complete statement is compiled showing the actual requirements, rough and finished stocks, work in progress, and outstanding commitments, the respective values calculated and a report submitted in order that special consideration may be given before rendering the material obsolete. Careful consideration is given to the fact that in some instances items rendered obsolete can be converted to the new design at very little cost.

MATERIAL CONTROL

The co-ordination of planned production depends very largely upon the amount of effective control exercised over material supplies, and it is most essential that close contact is maintained between those responsible for control of such supplies and outside manufacturers.

The Material Control Clerks are responsible for the control of all material supplies (Rough and Bought Out Finished) from outside sources in accordance with delivery requirements determined by the Planning Section as indicated on the Traders Schedules.

Traders Schedules.

These Schedules are compiled by the Planning Section and give details in regard to the Supplier concerned, Part Number and Description of Components, Order details and delivery requirements of each component as shown in the respective week or month required.

To: Messrs. COMPONENT METAL PRESSINGS. From:

THE ASSOCIATED AEC EQUIPMENT Co LTD

SOUTHALL

MIDDLESEX

MATERIAL DELIVERY SCHEDULE.

IMPORTANT NOTE: Do not manufacture any quantity on this Schedule unless you hold an Official Order from our Purchasing Agent.

The dates quoted are delivery dates AT THESE WORKS: PLEASE, THEREFORE, ALLOW NECESSARY TRANSIT PERIOD.

A separate Advice Note must be mailed to us for each Consignment.

All material sent back for replacement will be required in addition to the quantities quoted.

THIS SCHEDULE IS BASED UPON PLANNED CHASSIS PRODUCTION—ANY BREAKDOWN IN SUPPLIES WILL CAUSE US SERIOUS INCONVENIENCE.

PLEASE NOTIFY US IN ADVANCE IF YOU ARE UNABLE TO ADHERE TO THESE REQUIREMENTS.

PART No.	DESCRIPTION	ORDER No.	QTY. O/S	January 23	January 30	February 6	February 13	February 20	February 27	March 6	March 13	March 20	March 27	April 3	April 10	April 17	April 24	May	June	July
A.21441	Fan Blade	56107	3223								1500			1500				3000	1500	1623
		63009	2320																	
		68245	2720																	
		72440	600																	
		75369	260																	
A.21443	Fan Blade	72440	1530							500			500			530				
A 21450	Fan Blade	73515	12000		1200		1200		1200		1200		1200		1200		1200	2400	1200	
A.21462	Fan Blade	72611	300																	300

ALL DELIVERIES EFFECTED AFTER ADVICE NOTES DATED 16.1.43 TO BE DEDUCTED FROM THIS SCHEDULE.

Fig. 13

Two copies of this schedule are passed to the Order and Urge Section, and after being checked by the Urge Clerk, one copy is despatched to the Supplier and the other retained by the Urge Clerk for urge purposes. Contact is maintained by correspondence, 'phone or telegram with all suppliers, to ensure delivery requirements are maintained.

Receipts of consignments of material are recorded on the Traders Schedules from Advice Notes and Goods Received Notes against the respective Order Number and the Quantities outstanding are reduced accordingly.

Outside Material Control Representatives.

In cases where normal efforts by the Material Control Clerk to obtain supplies have failed a DOCKET, Form No. M.1097, is compiled giving details of the Order Number, Supplier, Component and Quantity Overdue.

These items are fully discussed at a Weekly Material Meeting held jointly by Outside Material Representatives and Material Control Clerks (see also page 461), and a decision having been reached in regard to the action to be taken, the dockets are handed to the outside representative in whose area the Supplier is located, in order that personal representation may be made by him to obtain direct information in regard to the possibilities of expediting supplies.

The Outside Material Representative, after visiting the Supplier concerned, completes the form with the information regarding future supplies which he passes to the Material Control Clerk concerned.

In the case of newly designed components when deliveries are invariably required immediately, it is the responsibility of the Material Control Clerks to ensure that there is the minimum of delay in placing the Purchase Order and adding item to the Trader's Schedule. Where new stampings and castings are required, the Material Control Clerk must ensure that all patterns and dies are completed without delay, and samples obtained and approved by the Inspection Department.

PROCESS AND RATE-SETTING SECTION

Functions.

Preparation of Time Studies, Compilation of Process Layouts, Operation and Tool Layouts, Target Time Investigations, Improved Methods, Plant Overhaul Processes, Preparation of Target Times for Estimates.

The principal function of the Process and Rate-setting Section may be briefly summarised as that of analysing design in relation to manufacture by planning a series of operations, co-relating these operations to time, thus providing the basis for Planning.

Process and Rate-setting requires expert knowledge of Pos-

sibilities and Limitations of Plant, Types of Machines required for each Operation, Sequence and Time required to perform each operation, Materials and Heat Treat Processes, and Jigs and Tools necessary for the economic production of the component part.

To carry out the functions of this Section, Process and Rate-setting Engineers are allocated to the various sections of the production departments and they are responsible for setting individual operation times and sequence of production operations for all component parts produced in the sections.

This Section commences its activities immediately upon issue of print of design, which is passed from the Material Control Section accompanied by the Production Release Note giving full details of the component.

The print is subjected to a close scrutiny in order firstly, to determine whether manufacture at Southall is an economical and practical proposition and secondly, to ensure that production problems in regard to Plant and Tools are, as far as possible, anticipated before the process layout is prepared.

Should design be of such a nature as to prove too costly to produce with existing plant, contact is made with the Design Department to ascertain if the design can be modified or, alternatively if justified by the quantity to be produced, obtain sanction for the purchase of special plant.

Preliminary Process Layout.

A preliminary survey having been made, a PRELIMINARY PROCESS LAYOUT, PPL-1, is prepared, one copy is sent with copy of Production Release Note to the Jig and Tool Department via the Planning Section for design of Tooling Equipment. The operation times on these layouts are at this stage estimated only.

Upon completion of all Tooling Equipment the preliminary layout is returned by the Jig and Ttool Department to the Process and Raté-setting Section, giving full details of the tooling equipment which actually will be provided for the manufacture of the component.

The Production Release Note is subsequently returned to the Process and Rate-setting Section via Planning Section after investigation by the Jig and Tool Department, duly endorsed with the estimated completion date for all Tooling Equipment called for on the process layout.

Time Studies.

A Time Study is meanwhile prepared for each operation, on an OPERATION DETAIL CARD, Form No. M.4023, incorporating in detail the actual floor to floor handling, positioning, gauging and

cutting times; results of this study are appended against each operation on the Master Process Layout.

Master Process Layout.

A MASTER PROCESS LAYOUT, form No. M.40291, is then prepared on which is stated full details of manufacturing operations, tooling equipment, production departments and machines concerned, also target times for each successive operation. The completed layout is then filed for reference by Process and Rate-setting Section.

Operation and Tool Layout.

From the Master Process Layout an OPERATION AND TOOL LAYOUT, form No. 05321, is compiled giving exactly the same details as are recorded on the Master Layout, Prints are taken from this tracing and affixed to the back of the print (boarded) of the component and issued to the Production departments when required via the Print Stores.

Alteration to Process.

In cases where, due to alterations to design or improved methods, Tooling Equipment is affected, the Process and Rate-setting section advise the Jig and Tool department on an ALTERATION TO LAYOUT, Form No. 5821, in order that any necessary adjustments or alterations may be made. A copy of this note is also sent to the Planning Section in order that provision may be made to bring the alteration into effect on work already in progress.

Upon completion of an alteration or addition to the Tool Layout the Jig and Tool Department advise the Process and Rate-setting Section on an ADVICE OF ALTERATION TO TOOL LAYOUT, Form No. M.0535, accordingly, in order that provision may be made to adjust where necessary operations or target times.

Target Time Investigation.

Under no circumstances is the Target Time allowed to be increased unless a thorough investigation has been made by the Process and Rate-setting Section and the existing target time proved to be insufficient. Consideration is only given to these complaints upon receipt of a TARGET TIME INVESTIGATION SLIP, Form No. 5818, from the Production Foreman concerned, when a motion study is made by the Section Process and Rate-setting Engineer of the operation concerned, with the aid of a stop-watch. The results of this study are then compared with the existing time allowed and adjustments made where necessary.

THE ASSOCIATED EQUIPMENT Co LTD

OPERATION AND TOOL LAYOUT — PART No F. 11822.

DESCRIPTION PINION/DIFF. BEVEL. MODEL MATERIAL NO. 28 STAINLESS. DATE 26/7/1939.

OPER No	OPERATION	M/C SYM	DEPT	TARGET TIME HRS	TARGET TIME MINS	FIXTURES, TOOLS, GAUGES	ALTERATIONS
	SPECIMEN.						
1	Heat treat Z.2		HT				
2	Drill and face for broach. Drill 29½ mm. dia.	ACA	PQ		3½		
3	Broach, leave for grinding	BRD	GR		1½	BROACH F.11822-3A. PLUG SL.874-26.	
4	Face and chamfer both sides. Leave .010" on small face and .004" on large face for grinding	HLD	PQ		5	PEG F.11822-4A. GAUGE F.11822-4B.	
5	Rough and finish turn two angular faces	AT	PQ		7	MANDREL F.11822-5A. GAUGES F.11810-2C, F.11822-5B.	
6	Rough cut teeth, 3 per setting	RM	GC		4	TERRE ARBORS F.11822-6A. GAUGE F.11810-5A.	
7	Finish cut teeth. NOTE: .004" is left on back face for grinding	BSB	GC		15	ARBOR F.11822-7A, F.11822-7B. PROFILE GAUGES F.11810-4B, 4E.	
8	Drill oil holes	RDS	GC		1	JIG F.11822-8A.	
9	Burr and trim teeth and stamp	SLAB	GC		4		
10	Heat treat Z.14, No. 28A.		HT				
11	Grind diameter	BGE	GR		1½	MANDREL SL.767-257. NEWALL GAUGE.	
12	Grind bore	IGH	GR		5	POT FIXTURE F.11822-12A. PLUG GAUGE SL.725-26. GAUGE F.11822-12B.	
13	Grind small face leaving .004" on large face, reverse and grind large face to width	RGD	GR		3	FIXTURE F.11822-13A.	

PART NO. F.11822.

Fig. 14

OPERATION DETAIL CARD.

Part Name: SLIDING WHEEL/1ST SPEED. **M/c Symbol** GHC. **Part No.** D.16518

Mat: NO. 14 STAMPING. **Operation.** 8. Finish cut teeth 4 per setting.

	Details.	Time		Details.	Time
1	Fix 4 gears on arbor and tighten up.	4.00			
2	Cutting 44 x 6.125 x 20 ÷ 104.5	51.00			
3	Wind back slide.	.50			
4	Gauging.	.50			
5	Dismantle	4.00			
		4 /60.00			
		15.00			

Actual time.	Time Limit.	Date.	Signed.
15.00	15 mins.	5.9.1939.	

FRONT

THE INSTITUTION OF PRODUCTION ENGINEERS

FRONT

ALTERATIONS.									
From	To	Reason.	Date	Sig.	From	To	Reason.	Date	Sig.

M.4023

BACK

Fig. 15

Plant Record Card.

To facilitate the preparation of Process Layouts, a PLANT RECORD CARD, Form No. 5808, is maintained in the Process and Rate-setting Section of all available Plant, giving details of Machine Capacity, Speeds and Feeds and Location.

Non-Standard Operation Process Layouts.

The same procedure is followed as in the standard process layout but in place of the master process layout a "White Paper" Operation and Tool Layout is issued.

These layouts are only issued for Non-standard batches of work, alternative methods of production.

One copy is passed to Central Time Office for recording purposes, one to Jig and Tool Department for provision of tooling equipment, one to Production Departments via the Planning Section and one retained in Process and Rate-setting Section for reference.

Upon completion of the batch of work the process layout is returned to Print Stores and scrapped.

Special Process Layouts are also compiled for Experimental Work, Alternative Materials and other work requiring special attention during process of manufacture. These layouts are printed in various colours to indicate the various categories under which the work is to be processed, viz :

Experimental Work and work requiring special attention	= Orange.
Alternative Materials	= Green.

Estimating for Work Placed by Outside Firms on A.E.C.

Blue prints or drawings of the components concerned are submitted by the Accountant's Department to Process and Rate-setting Section, for preparation of process layout.

When compiling the layout, consideration is given wherever possible to allocating these jobs to idle plant.

Copies of this process layout are passed to Planning Section, for investigation of machine load and delivery dates, to Jig and Tool Department, for provision and cost of tooling equipment and completion dates of same, and one copy retained in Process and Rate-Setting section.

A copy of the completed process layout, giving full details of job times, tooling equipment and delivery dates, is passed to the Accountants Department for preparation of final costs.

Stamping Drawings.

When ordering supplies of stampings, necessitating the provision of new dies, the Purchasing Agent passes an enquiry requisition to

the supplier concerned together with four copies of the print of the component.

After investigation, the supplier retains one copy of this print and returns the remaining three copies on which he outlines in red the form in which he proposes to supply the stamping.

Copies of these drawings are passed via the Process and Rate-Setting Section, to the Production Superintendent and Jig and Tool Superintendent for approval.

Upon approval, one copy is returned to the supplier, indicating where necessary, modifica ions to suit manufacture, one copy passed to Inspection Dept. for reference pending delivery of stampings, and one to Specification Section for record and filing.

Process Layouts for Plant Overhaul.

Process layouts are prepared by the Process and Rate-setting Section for all plant and machinery requiring overhaul.

Notification of impending overhaul of a machine is passed to the Process and Rate-setting Section by the issue of a Factory Order by the Plant Engineer, on which is given particulars of the machine, type, number and location.

Target times are then fixed for the removal of the machine and transport from site to the plant overhaul section and also for stripping down, washing and examining parts removed.

This information is recorded on a preliminary process layout.

The Process and Rate-setting Section Engineer, concerned with plant, overhaul, is present while the parts are being stripped and examined and from his observations builds up a process layout giving particulars of each operation, machine type on which the operations are to be performed and the job times necessary for each operation required to complete the overhaul of the machine.

Upon completion of the master process layouts, one copy is sent to the Plant Engineer, one to Central Time Office and one retained in Process and Rate-setting Section.

Upon completion of the overhaul, the machine is returned to the section concerned, grouted in, and adjusted (the job times of these operations being incorporated in the layout) and the Factory Order is signed by the Plant Engineer and passed to Central Time Office indicating that all work has been completed.

The Section foreman signs the clearance note when he is satisfied that the machine is running correctly.

Process Layouts—Assembly and Erection Departments.

Process Layouts and Time Studies are also compiled for all detail fitting, assembly and erection processes, Target Times being fixed for each individual operation in accordance with normal procedure.

Target Times are also fixed for all work in Clerk of Works Depart-

ment, Pattern Shop, Battery Shop, etc., in these instances Process layouts are provided where necessary or Target Times are endorsed on all copies of the orders which have been issued covering the work to be done.

Meetings.

The Chief Process and Rate-setting Engineer attends the weekly meetings of Production Superintendent to discuss Production Problems; also improved methods meeting attended by Senior Production Executives, to discuss matters relating to improved methods of production, suggestions received from employees, etc. (See also page 457)

PLANNING SECTION

Functions.

Preparation of Planning Studies, Determining Economic Batch Quantities and Priority Periods, Compiling Tooling Equipment Schedules, Factory Schedules and Traders Schedules, Construction of Planning Schedules, Issue of Batch Cards, Construction of Machine Loads.

The principal function of the Planning Section is that of analysing all the elements of a Production Programme and prescribing in advance when all these elements should be put into effective operation.

The various stages of production processes are carefully examined and plans formulated to ensure that all Tools, Materials, Plant and Labour become available at the right time and place in order that all production processes are synchronised to permit the completion of a manufacturing programme during a pre-determined period.

Planning Routine commences from the receipt of Production Release Note from the Ratefixing Section, together with the Preliminary Process Layout.

Planning Study.

From this Layout a preliminary PLANNING STUDY, Form No. M.1053, (Fig 16) is constructed in order that the Economic Batch Quantity and Machining Priority may be determined. This study is an analysis, operation by operation, of the number of hours, with a summary in weeks, required to produce a machining batch of economic quantity.

The ECONOMIC BATCH QUANTITY is, in general principle, a batch size which eliminates the necessity for setting-up times and allows the longest possible run of any one component consistent with normal bulk of work in progress.

The MACHINING PRIORITY constitutes the average time, in weeks, taken to cover all manufacturing operations at Southall on a batch of economic quantity.

A special CALENDAR, Form No. CA-1 (Fig. 17), is prepared for the use of all concerned, a Week Number being allocated to each Calendar Week. The " week number " is used on all Planning Schedules and documents where such information is necessary.

Jig and Tool Schedule.

The Planning Section then refer to the Production Schedule, Form No. PR-1, to determine the date and rate of production requirements and proceed to compile a TOOL SCHEDULE, Form No. T.E.-1 (Fig. 18), showing all Jigs and Tools required for each operation and the week in which they must be completed to synchronise with production requirements. This schedule is constructed from the Process Layout and Planning Study, and constant pressure is maintained on the Jig and Tool Dept. by the Planning Section, to ensure that the tackle is available in accordance with schedule requirements.

On completion of all Jigs and Tools for each component, the Temporary Process Layout is passed to the Rate-setting Section via the Planning Section in order that any adjustments may be incorporated in the final layout.

If the Tooling Equipment is not comp'eted by the date specified in the Tool Schedule, the Planning Section issue to the Process and Rate-setting Section an URGENT DRAWING AND LAYOUT REQUEST, Form No. DLR-1, asking for the issue of a Process Layout covering the operations for which all Tooling Equipment is available. Subsequent operations are added to the layout by the Process and Rate-Setting section on the advice from the Planning Section that the necessary Tooling Equipment has become available.

In some cases, mainly due to late changes in design, where none of the Tooling Equipment is available, application is made by the Planning Section to the Process and Rate-setting Section for the issue of a temporary Process Layout providing for alternative or " free-hand " methods.

This arrangement precludes the possibility of urgent work being held up due to lack of Tooling Equipment.

Planning Schedule.

A PLANNING SCHEDULE, Form No. P.1 (Fig. 19), is next constructed showing the weekly building rate of Chassis and main units and the total number of chassis of each particular type outstanding each week, in accordance with requirements called for on the Production Schedule.

Details are also given in regard to the weekly total of chassis outstanding in accordance with machining rate shown on Factory Schedule.

PLANNING STUDY

ECONOMIC BATCH	Advance.	PART NO.& DESCPTN.
240	Final Typed 7.11.39 Register Load Cards.	F.11822 Pinion.

Op.	M/c	Bay	Op. Mins.	Job Hrs.	Wtg. Hrs.	View & T'port	Total Hours.	Weeks	Index
1	Z.2	HT	-	20	8		28	1	
2	ACA	PQ	3¾	15	24	8	75	2	
3	BRD	GR	1½	6	8	8	97	2	
4	BLD	PQ	5	20	12	8	137	3	
5	AT	PQ	7	28	18		183	4	
6	BM	GC	4	16	30	8	237	5	
7	BSB	GC	15	60	30		327	7	
8	RDS	GC	1	4	12		343	8	
9	SLAB	GC	2	8	12		363	8	
10	Z14	HT	-	60	12	8	443	9	
11	EGE	GR	1½	6	12	8	469	10	
12	IGH	GR	5	20	12		501	11	
13	RGD	GR	3	12	12		525	12	

M.1053.

Fig. 16.

C A L E N D A R.
SHEWING RELATION OF WEEK NUMBER TO DATE
1943-1944.

	JULY					AUGUST				SEPTEMBER				OCTOBER					NOVEMBER				DECEMBER			
Weeks:-	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Sunday	27	4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19
Monday	28	5	12	19	26	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20
Tuesday	29	6	13	20	27	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21
Wednesday	30	7	14	21	28	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22
Thursday	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23
Friday	2	9	16	23	30	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24
Saturday	3	10	17	24	31	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25
	JANUARY					FEBRUARY				MARCH				APRIL					MAY				JUNE			
Weeks:-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Sunday	26	2	9	16	23	30	6	13	20	27	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18
Monday	27	3	10	17	24	31	7	14	21	28	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19
Tuesday	28	4	11	18	25	1	8	15	22	29	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20
Wednesday	29	5	12	19	26	2	9	16	23	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21
Thursday	30	6	13	20	27	3	10	17	24	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22
Friday	31	7	14	21	28	4	11	18	25	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23
Saturday	1	8	15	22	29	5	12	19	26	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24

ISSUED BY PLANNING SECTION.
JUNE 1943.

Fig. 17

TOOL SCHEDULE

TOOL ABBREVIATIONS:- VE AND VP PROGRAMME

A Arbor
B Bar
C Cutter
D Dividing Plate
E Cutter Head
F Fixture
G Gauge
H Hob
J Jig
K Head
L Adaptor
M Mandrel
N. Spacing Collar
P Bush
R Reamer
S Spigot
T Tools
V Vice Jaws
W Jaw
X Special Parts
Y Broach
Z Master Gear

Part No.	Description	Priority	NOVEMBER					DECEMBER				JANUARY				FEBRUARY		
			2	9	16	23	30	7	14	21	28	4	11	18	25	1	8	15
			44	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7
F.10151	Front Axle	7								1	2	3-4	-	5-6	7-8-9	10-11-12		
F.15270	Shaft	9						GGXX TTOO 1-3	FGFBG GFGXX 4-6	FG FG 9-11	X 12-13	14	15-17	18-19	XXFGX FG 20-22	23		
F.15271	"	9						GGXX TTOO 1-3	FGFBG GFGX 4-8	FG FG 9-11	X 12-13	14	15-17	18-19	XXFGX FG 20-22	23		
F.15272	"	9						TGG FX 1-3	FGGG FGXX 3-4	HXX FG 5-6-7	X 8-10		11-12	XX 13	XGX FG 14-17	18		
L.25304	Spring Carrier	13		1-2	WXX GTX 3	FGTG FX 4	5	FXX GX 6	FG 7	FXG FTXG 8-9	FXXX GTGG 10-11	FFTG XX 12	FG 13	FFTG XXF 14-15	JTG JX 16-17	FG 18-19		
T-1																		

Fig. 18

J | PLANNING SCHEDULE | 3rd FEBRUARY 1943 | J

S	0853.Y	0853.Y	0854.S	0854.S	0856.P	0857.N	Y.S.P.	Y.S.	Y.P.	Y.S.	Y2.S1.P2.	Y1.S2.P1.	S

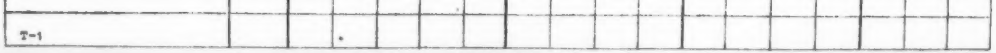


Fig. 18

| J | PLANNING SCHEDULE | | |

The difference between these two figures constitutes a material float between the manufacturing and assembly departments.

Traders Schedules.

TRADERS SCHEDULES, Form No. M.1043, are compiled by the Planning Section from the Planning Schedule, due reference being made to Master Record Cards for existing stocks and work in progress, also to the Production Schedule for Production requirements. These Schedules cover a period of four months and are issued to the order Section in duplicate, one copy being retained by the Urge Clerk for urge purposes and the other being sent to the supplier concerned.

On these schedules details are stated in regard to Date of Issue, Name and Address of supplier, Part Number and description of Components, Order Number and Quantity Outstanding, also Delivery Requirements of each component under the respective week.

Factory Schedule.

A FACTORY SCHEDULE, Form No. ST.4068 (Fig. 20), is also prepared from the Planning Schedule and in compiling this Schedule, due reference is made to the Master Record Card to ascertain existing stocks and work in progress and to the Planning Study for machining periods and batch quantities. In this schedule is inserted under the appropriate weeks, the quantities of each part number required to be started by the Production Department concerned.

The period covered by Factory Schedules is approximately six months and these are revised every three months. A copy of the Factory Schedule is passed to the Order Section for the issue of Material Requisitions and the issue of rough material to the Factory is entirely governed by this schedule which is strictly adhered to.

Material Requisitions are issued by the Stores Order Section and passed to the Planning Section three weeks before the date on which material is due for issue to the Production Departments, as indicated on the Factory Schedule.

From the Material Requisition the Planning Section prepare the Job Card, both documents being retained by the Planning Clerk responsible for release to Rough Stores (via Progress Section) at the correct date.

If the material is not available, the Material Requisition is stamped "Waiting Material" by the Stores Order Section and passed to the Planning Section in accordance with normal procedure, for the issue of a Job Card which is filed in "Waiting Material" box, and the Material Requisition returned to the Stores Order Section, pending receipt of material.

A list is compiled from the Job Cards in the "Waiting Material"

box of all items outstanding and submitted for discussion at the weekly meeting of Material Urge Representatives.

A daily list is prepared by the Planning Section and issued to Progress and Rough stores of all batches of material released to the Production Departments.

Job Card.

The JOB CARD, Form No. M.1038 (see Fig. 21), is issued with each batch of work and accompanies the job throughout various manufacturing processes. On this card is denoted the Part Number of component, Batch Symbol (combination of Programme Symbol and Starting and Finishing week numbers for that Batch), Quantity, Operation Numbers, Machine Symbols, Shop Number and the Number of the week in which each operation must be completed (See Special Calendar : Fig. 17).

Job Cards are issued in different colours under the following headings :

White	=	Indicating normal machining period.
Pink	=	Indicating express priority.
Orange	=	Indicating experimental process.
Green	=	Alternative Material.

Job Label.

A JOB LABEL, Form No. 4065, accompanies each batch of work throughout all the manufacturing operations and indicates the Part Number of the component, Batch Quantity, Batch Symbol and Operations completed.

Plant Record.

A " COPE-CHATTERTON " CARD INDEX, Form No. P.2, is maintained in the Planning Section, on which particulars are recorded of Machine Symbol, Number and Description and Section concerned, a separate card being issued for each machine.

Reference is made to this record when compiling machine load summaries.

The Planning Section is advised by the Plant Engineer by the issue of MACHINE TOOL MOVEMENT NOTICE, Form No. M.1048, immediately plant movement has been effected, and the records are adjusted accordingly.

Machine Load Detail Sheets.

To enable the Planning Section to determine the machine load on any particular production section at a given period, a Detailed Machine Load is constructed on FACTORY SCHEDULE MACHINE LOAD, Form No. 1080 (see Fig. 22).

Machine Bay _____ Foreman _____

FACTORY SCHEDULE

From Week 7 (1941) To Week 35 (1941)

BATCHES ARE SHOWN IN STARTING WEEKS

Part No.	Section	Economic Batch	Machining Priority	Originated	Model Symbol	FEBRUARY			MARCH				APRIL				MAY					JUNE				JULY					AUGUST.		
						13	20	27	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	14	21	28
						7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35
V.36001	BF FQ	2400	3	AMF	S.R.G.	240																										
V.36008	BF SH FQ	360	3	MTA	S.R.G.			360				360										360										
V.36022	FH	60	9	CCE						60																						
V.36042	BF FQ	60	2	BTD					60																							
V.36050A	FH FQ SH	90	7	YMC										90																		
V.36051	FH	60	9	CCE	S.R.G.	60		60		60		60		60		60		60		60	60		60	60			60			60		60
V.36052	BF GR FQ	120	6	MTB	S.R.G.	60			60				60				60				120					120						120
V.36066	7/10	360	3	PDB	S'(KF)	360																						240				
V.36067	15/18	60	3	PDB	S'(KF)		60		60				60						60			60			60			60			60	
V.36071	BF FQ	300	4	MTD					300																							
V.36084	13 15/18	120	4	CTA			120					120					120																
V.36085	13 15/18	120	4 & 4	CTA	S.R.G.	60	A14		60	A16					60			60			60		60			150					120	

/ = Material Regn: Issued.

X = Ready for Issue.

X = Issued to Shops.

JOB CARD

BATCH	QUANTITY	PART NUMBER
VO. 20/31	240 PINIONS PROG. 240 SS... NIL SU... NIL	F.11822

Op.	Mc.	Shop	Week	Started.	Fin'd	O.K.	Scrap	Viewer.
1	Z.2	HT	20					
2	ACA	PQ	21					
3	BRD	GR	21					
4	ELD	PQ	22					
5	AT	"	23					
6	BM	G.C.	24					
7	BSB	"	26					
8	RDS	"	27					
9	SLAB	"	27					
10	Z.14	HT.	28					
11	EGE	G.R.	29					
12	IGH	"	30					
13	RGD	"	31					
	V.R.							

NOTE: Alterations and additions may be made by Office only.
M.1038 Issued 31.5.41.

WHITE Card issued for Normal use.
PINK Card issued for Express Priority.
ORANGE Card issued for Experimental Layout.
GREEN Card issued for Alternative Material.

Fig. 21

FACTORY SCHEDULE MACHINE LOAD — SHOP *FH-1* WK-30

GROUP	ELD	ELE	CCE	CTA	CTB	CTC	CTD	CTE	ACB	VMB	VMC	HMB	HMJ	HM BH	PDB	PDD	PDS	PD2	PD3
J.4				45							3	11		14					
				38							4	16							
				38							5	10							
											8	25							
				121							20	62		14					
5.J	28									6	4	5			4				
											23	6			6				
											10	21			6				
												6			6				
												6			24				
												21			17				
												16			13				
															11				
															8				
										6	37	81			95				
6.J											7	4			6		28		
												20			16				4
												13							24
												15							
												10							
												44							
												10							
												27							
												6							
												27							
												17							
M.1080/13.											7	193			22		28		28

SUMMARY

SHEET NO. 1/1 — MACHINE LOAD. — DATE WEEK 47 - WEEK 9. — BAY: E. (CAMSHAFTS)

M.1080/13.																		7		193				22		28		28			

SUMMARY.

MACHINE LOAD.

SHEET NO. 1/1 — DATE WEEK 45 - WEEK 9. — BAY: E. (CAMSHAFTS)

		1	1	1	1	1		1	1	1	2	1		1	1	1	1			
MONTHS.	WEEKS.	LL	LLB	ELD	ELJ	C	SUB TOTAL	SD	EGD	EGE	EGJ	ECL	SUB TOTAL	KS	PCMA	PCTA	SLAB	STR	SUB TOTAL	GRAND TOTAL
November.	45	61.0	40.0	27.5	-	6.0	134.5	2.0	-	141.0	112.0	26.0	279.0	35.5	-	90.0	46.0	52.0	223.5	639.0
	46	61.0	40.0	58.0	-	6.0	165.0	4.0	-	95.5	186.0	26.0	307.5	9.5	-	60.0	39.0	104.0	212.5	689.0
	47	30.0	20.0	58.0	-	3.0	111.0	2.0	-	199.5	146.0	-	345.5	28.0	-	120.0	72.0	104.0	323.0	781.5
	48	61.0	40.0	43.0	-	6.0	150.0	3.0	-	149.5	146.0	26.0	321.5	22.5	-	120.0	41.0	99.0	282.5	757.0
Average		53.2	35.0	46.6	-	5.2	140.1	2.7	-	146.4	147.5	19.5	313.4	23.8	-	97.5	49.3	89.7	260.3	716.6
December	49	61.0	40.0	42.5	-	6.0	149.5	3.0	-	121.0	146.0	26.0	293.0	22.5	-	60.0	42.0	57.0	181.5	627.0
	50	30.0	20.0	58.0	-	3.0	111.0	3.0	-	95.5	146.0	-	241.5	9.5	-	120.0	39.0	104.0	272.5	628.0
	51	61.0	40.0	43.0	-	6.0	150.0	2.0	-	141.0	86.0	26.0	253.0	22.5	-	120.0	41.0	99.0	282.5	687.5
	52	61.0	40.0	42.5	-	6.0	149.5	3.0	-	121.0	146.0	26.0	293.0	22.5	-	60.0	42.0	57.0	181.5	627.0
Average		53.2	35.0	46.5	-	5.3	140.1	2.7	-	119.6	131.0	19.5	270.1	19.2	-	90.0	41.0	79.2	229.5	642.3
January	1	30.0	20.0	58.0	-	3.0	111.0	4.0	-	95.5	146.0	-	241.5	9.5	-	120.0	57.0	104.0	290.5	647.0
	2	61.0	40.0	43.0	-	6.0	150.0	2.0	-	149.5	86.0	26.0	261.5	22.5	-	120.0	66.0	99.0	307.5	721.0
	3	61.0	40.0	42.5	-	6.0	149.5	3.0	-	121.0	146.0	26.0	293.0	12.5	-	60.0	42.0	57.0	171.5	617.0
	4	30.0	20.0	58.0	-	3.0	111.0	3.0	-	95.5	146.0	-	241.5	9.5	-	120.0	39.0	104.0	272.5	628.0
	5	61.0	40.0	43.0	-	6.0	150.0	2.0	-	149.5	86.0	26.0	261.5	22.5	-	120.0	41.0	99.0	282.5	696.0
Average		48.6	32.0	48.9	-	4.8	134.3	3.0	-	122.2	122.0	15.6	259.8	15.3	-	108.0	49.0	92.6	264.9	661.8
February	6	61.0	40.0	42.5	-	6.0	149.5	3.0	-	121.0	146.0	26.0	293.0	22.5	-	60.0	42.0	57.0	181.5	627.0
	7	30.0	20.0	58.0	-	3.0	111.0	3.0	-	95.5	146.0	-	241.5	22.5	-	120.0	42.0	104.0	288.5	644.0
	8	61.0	40.0	43.0	-	6.0	150.0	2.0	-	149.5	86.0	26.0	261.5	22.5	-	120.0	41.0	102.0	285.5	699.0
	9	30.0	20.0	42.5	-	3.0	95.5	4.0	-	121.0	146.0	26.0	293.0	22.5	-	60.0	42.0	57.0	181.5	574.0
Average		45.5	30.0	46.5	-	4.5	126.5	3.0	-	121.7	131.0	19.5	272.2	22.5	-	90.0	41.7	80.0	234.2	636.0
March	10	66.0	40.0	43.0	-	6.0	155.0	3.0	-	95.5	146.0	-	241.5	9.5	-	120.0	63.0	99.0	291.5	691.0
	11	61.0	40.0	58.0	-	6.0	165.0	2.0	-	129.5	86.0	26.0	241.5	22.5	-	60.0	42.0	104.0	228.5	637.0
	12	30.0	20.0	42.5	-	3.0	95.5	3.0	-	141.0	146.0	-	287.0	22.5	-	120.0	42.0	57.0	241.5	627.0
	13	61.0	40.0	43.0	-	6.0	150.0	3.0	-	95.5	146.0	26.0	267.5	9.5	-	180.0	38.0	99.0	266.5	687.0
Average		54.5	35.0	46.6	-	5.2	141.3	2.7	-	115.3	131.0	13.0	259.3	16.0	-	105.0	46.2	89.7	257.0	660.5

ML.2.

Fig. 23

On this statement indication is given of the Production Section or Departments concerned and a separate sheet is compiled for each consecutive week in which the various production operations become due, also the Production Department concerned.

Columns are provided in which job times (in minutes) per batch are inserted under the appropriate machine type or symbol.

Machine Load Summary.

To enable the Planning Section to determine whether the machine capacity is capable of achieving the requirements shown on the Factory Schedule, a MACHINE LOAD SUMMARY, Form No. ML.2. (see Fig. 23), is constructed constituting a summary of accumulative totals of all manufacturing hours on each type of machine under the appropriate week, a separate load being made for each Production Department.

In compiling the Machine Load Summary the following documents are referred to :

(a) Factory Schedule	For quantity and machining rate, starting week for first operation and Production Department concerned.
(b) Planning Study	To determine starting week and machine type for each successive operation in order that the machine load is correctly allocated to each type of machine and the appropriate week each operation is due to be machined.
(c) Accumulated Load Card	Indicating the gross manufacturing times (in minutes) per batch on each type of machine on any one week.
(d)Machine Load Detail Sheet	To determine the weekly load on each section per machine type.

A record is kept on "Cope-Chatterton" Card Index (P.3) of each individual component and operation on which details are recorded of Part Number and Description of component, Model of each component used, Operation and Machine Type, Section concerned and Target Time.

From this record a Machine Load can be quickly constructed for any particular Model, Unit, Machine Type or Production Section.

Departmental Machine Load Summary.

To enable production supervision to determine whether existing labour strength is capable of achieving the requirements indicated on the Factory Schedule, a DEPARTMENTAL MACHINE LOAD SUMMARY, Form No. ML.1 (Fig. 24), is prepared for each production section or

department, and copies are distributed to all production supervision concerned in order that they may make any adjustments that may be necessary in regard to overtime or nightshift to fulfil production requirements.

On this statement details are given of the Period under Review, Machine Groups and Symbols, Section concerned and the total number of each type of machine affected.

Columns are provided for the average machine loads per machine type under the respective month in which the operations are due, and also for the necessary labour strength involved in each respective month per machine type.

Details for the construction of this summary are compiled from the Machine Load Summary.

Supplementary Assistance from Outside Sources.

(*Outside Machining Procedure*).

In most organisations, particularly when the production departments have reached a maximum capacity, there occur periods when " bottle-necks " begin to appear, with a retarding effect on production.

Whilst the majority of these " bottle-necks " have already become apparent from the Factory Machine Load and effective action will previously have been taken before the retarding influence is felt, certain factors emerge which cannot be foreseen, such as Breakdown of Plant and Key Machines for unduly long periods, abnormal epidemic of sickness of operators and a long run of defective material. This results not only in a congestion of a particular type of machine but to succeeding operations which are consequently thrown out of balance.

As these conditions are usually created by abnormal circumstances the purchase of additional plant would only tend to unbalance the manufacturing department when conditions again return to normal, even if the additional plant could be obtained in time.

Therefore, if the plant is already working to full capacity and no alternative method of production can be adopted, the only course usually left open is to procure assistance from outside sources.

This function is performed by the Planning Section by whom a record is kept of all sources from which such assistance has already been rendered and who, by personal contact of technical representatives of the Production Control Department, have been proved to possess the proper facilities in regard to Plant, Labour, Inspection and other services.

When an overload is shown on a particular Section or Machine Type, an investigation is made by the Planning Engineer and after consultation with the Production Superintendent and Chief Progress

Man, suitable work is selected which will give the necessary relief to the Machine Load.

The rough material position is then investigated and delivery requirements ascertained.

A suitable sub-contractor is next selected from the register, to whom a visit is arranged by a technical representative from the Production Control Department in order that agreement may be reached on all technical matters, delivery requirements, tooling requirements, and methods of fixing prices. These arrangements are subsequently confirmed by letter.

Contact is then made with the Jig and Tool Department to ascertain if Tooling Equipment can be loaned by A.E.C. or, alternatively, to obtain sanction to duplicate the necessary tooling at either the A.E.C. or sub-contractors.

When agreement has been reached on all these points, the Planning Section issue a Requisition to the Purchasing Agent by whom an official order is subsequently placed. (The requisition is first passed to the Order Section for recording on the Master Record Card, the Master Card being endorsed in red signifying the existence of a supplementary card).

An "OUTSIDE MACHINING INSTRUCTION" (OM.2) is next prepared by the Planning Section and copies circulated to Accounts, Central Time Office, Goods Outwards and Progress Section.

On receipt of this document, the Progress Section (if job is already work in progress) arrange for the Section Viewer to inspect the work and issue a Pass Forward Slip for the operations completed, depositing the Job Card and Pass Forward Slip in the Planning Section and passing the batch of work to the Goods Outwards. The Batch Card is endorsed by the Planning Section with the operations completed and filed pending the return of the job from the sub-contractor.

The Goods Outwards arrange for the batch of work to be despatched to the sub-contractor together with the Advice Note, a copy of which is passed to the Stores Order Section and Planning Section for recording purposes.

Meanwhile, the Planning Section prepare a "JIG AND TOOL INSTRUCTION," Form No. OM 3, giving full details of the job and Tooling Equipment required. A copy of this document is passed to the Jig and Tool Department who arrange for the collection of the necessary Tooling Equipment from the various manufacturing departments and after inspection, pass to Goods Outwards for despatch with the batch of work to the sub-contractor.

An "OUTSIDE MACHINING RECORD CARD," Form No. D.1106, is originated by the Planning Section, on which is recorded particulars of the order and details of the despatch and receipt of material,

A.E.C.SOUTHALL.		(DEPARTMENTAL) MACHINE LOAD					SHOP:- 14 (Valves & Guides.				
Mr. Davis (RF) Mr. Jones (WM) Mr. Pollard Shop Foreman P.C.D. Copy		Set out below is a statement of hours committed and men required calculated on a 50 hour working week. Estimated at 100% Target Times.					Apl.-July, 1943. PROGRAMME. 55 Chassis. 20 Tank Engines. Spares.				
M/c GROUP	SYMBOL	LOAD, HOURS PER WEEK				M/cs Avbl	MEN REQUIRED.				
		Apl.	May	Jun.	Jul.		Apr.	May	Jun.	Jul.	
CAPSTANS	CCA	433	424	342	373	4)	10.5	10.6	8.5	9.1	
	BTA	90	108	81	82	2)					
TOTAL.....		523	532	423	455	6	10.5	10.6	8.5	9.1	
CHUCK AUTOS	ACM	183	180	137	177	2	3.7	3.6	2.7	3.5	
HOR. MILLS	HMA	20	20	15	4	1	.4	.4	.3	.1	
EXT. GRINDERS.	EGA	57	81	71	67	1)	10.0	11.9	10.5	9.9	
	EGC	249	292	255	230	4)					
	EGD	196	223	197	196	1)					
	CGA	140	157	133	132	3	2.8	3.1	2.7	2.6	
TOTAL.....		642	753	656	625	9	12.8	15.0	13.2	12.5	
MISC.	KS	90	90	115	120	1	1.8	1.8	2.3	2.4	
	SPA	37	26	28	26	1	.7	.5	.6	.5	
	COA	21	15	19	17	1	.4	.3	.4	.3	
	STAMP M/C.	13	20	18	17	1	.3	.4	.4	.3	
	SLAB	31	25	26	23	-	.6	.5	.5	.5	
TOTAL.....		192	176	206	203	4	3.8	3.5	4.2	4.0	
GRAND TOTAL.....		1560	1661	1437	1464	22	31.2	33.1	28.9	29.2	

SPC/ERC/WG.
4.5.43.

ML.1

Fig. 24

the Machine Load relief is also recorded on the reverse side of the Card.

The Factory Schedule is endorsed in order that future issues may be adjusted and the Machine Load is subsequently revised.

A Delivery Schedule is constructed by the Planning Section showing delivery requirements, one copy is passed to the sub-contractor and one retained by the Planning Section for reference.

Contact is maintained with the sub-contractor whilst work is in progress to ensure that the job is proceeding satisfactorily.

Upon completion of work at the sub-contractors the job is returned to the A.E.C., booked in by Goods Inwards on Goods Received note and passed to the View Room for inspection, after which the Goods Received Note is signed by the Viewer showing the quantity passed, rejected or scrapped.

If the work is completely finished, it is passed direct to the Finished Stores, but if only partly machined is re-issued to the shops by the Planning Section accompanied by the original job card.

Upon completion of the contract, it is the responsibility of the Planning Section to ensure that all tooling equipment, the property of A.E.C., is returned to Southall.

Upon receipt of tooling equipment, a Goods Received Note is issued by the Goods Inwards, copies of which are passed to Jig and Tool Stores, Accounts and Planning Section.

Tooling Equipment is collected from the Goods Inwards by the Jig and Tool Department, inspected and returned to the Section Tool Stores from whence issued.

A record (Form No. OM.1) is kept in Main Jig and Tool Stores, on which is recorded details of the despatch and receipt of all tooling equipment used in connection with each contract.

A weekly report is compiled by the Planning Section showing the orders placed on Outside Contractors during the previous week, total hours relief on Machine Types affected and gross total number of machine hours relief secured, copies of this report issued to Works Manager, Production Superintendent, Assistant Accountant (Costs), Progress Section.

SUB-CONTRACT MACHINING WORK UNDERTAKEN BY A.E.C.

In cases where production requirements prove inadequate to keep the plant employed to full capacity, work is accepted from outside sources to balance the underload.

Preliminary Negotiations.

All enquiries from such sources are passed by the Assistant Accountant (Estimating Section) to the Planning Section for

investigation in order to ascertain if suitable plant and machine capacity is available.

Agreement is then reached between the Production Superintendent, Chief Process and Rate-setting Engineer, and Planning Engineer in regard to acceptance of order, also with Jig and Tool Superintendent if Tooling Equipment is to be provided or loaned by A.E.C.

A provisional Process Layout is then prepared by the Process and Rate-setting Section and passed to the Planning Section, from which approximate delivery periods and rates are determined.

This information, together with a copy of the Process Layout and all original documents, is returned to the Assistant Accountant (Estimating Section) for preparation of quotation which is passed to the contractor concerned.

Acceptance of Order from Contractor.

In certain exceptional cases, with the approval of the Chief Accountant, orders are accepted on a "price to be agreed" basis, but it is essential that ALL orders for sub-contract work are first submitted to the Chief Accountant for scrutiny, to ensure that the terms and conditions of order comply with the Company's policy in regard to acceptance.

Upon receipt of the Customer's official order, the Planning Section will pass same to the Order Section for initiation of a Master Record Card on which details will be recorded and the order passed to the Spares Department.

Issue of "S.S." and Works Orders.

From details recorded on the customer's order, the Spares Department will issue a SPARES ORDER covering the work to be performed, which they will pass to the Stores Order Section, retaining the customer's order for reference.

Upon receipt of the Spares Order, the Stores Order Section obtain from the Specification Section a WORKS ORDER, Form No. 4022, on which will be stated full details of the work to be carried out and will also be endorsed with the Spares Order Number and the signature of the Works Accountant.

The Stores Order Section will enter on the Master Record Card, details of the Spares and Works Order Numbers and pass the Works Order to the Planning Section, retaining the Spares Order for filing.

Issue of Process Layout.

A Process Layout is obtained from the Process and Rate-setting Section by the Planning Section and attached to the Works Order. When parts are to be made from bar material (or tube) the length required to make one component is entered on the Process Layout.

Economic Batch Quantity.

In cases where large quantities are involved, necessitating the work being split into many batches, a Planning Study is prepared to determine the economic machining quantity and the period required for machining.

Factory Schedules.

On these calculations and delivery requirements shown on customer's order, a Factory Schedule is compiled, a copy of which is passed to the Stores Order Section for the issue of Material Requisitions.

Material Requisitions.

When issuing Material Requisitions, the Stores Order Section will quote, in lieu of the Programme Symbol, the Works Order Number also the "week dates."

Details of the material from which the parts are to be made are also entered on the Material Requisition and when parts are to be made from Bar or Tube, the length required to make one part is also stated.

Issue of Job Cards and Job Labels.

The Material Requisition is then passed by the Stores Order Section to the Planning Section for the issue of Job Cards and Job Labels which, together with a copy of the Factory Schedule, are passed to the Frogress Section.

Control of Work in Progress.

The Progress Section is responsible for the issue of the material to the Production Departments, in conformity with the Factory Schedule, also the progression of work through the shops in accordance with the dates shown on the Job Cards.

Receipt and Despatch of Completed Work.

Completed work is passed to the Finished Stores together with Job Card and Pass Forward Slip, in accordance with normal procedure. Details of quantity and date received are recorded on the Master Record Card and the material passed to the Spares Department for despatch to contractor in accordance with terms of order.

The Planning Section maintain contact with the customer until completion of the order, and all correspondence in connection with these matters is centralised in the Planning Engineer.

GOODS INWARDS SECTION

Functions.

Receiving, Handling and Checking Material Supplies, Despatch of Material, Checking Freight Charges and Accounts.

An essential function in a large manufacturing organisation is the provision of effective facilities for the reception of Material. Efficient methods of handling must be provided and adequate control exercised over checking to ensure that consignments of material conform with instructions contained in the Purchasing Order.

Active planning becomes operative immediately upon receipt of material and all incoming material must, therefore, be promptly unloaded, checked and identified with Delivery Notes and transported to its destination with the minimum of handling and delay to avoid loss or damage and to conserve floor space which is usually very limited.

These functions are undertaken by the Goods Inwards Section under the supervision of the Chief Storekeeper.

The Goods Inwards extends the whole length of the Main Factory and adjoins the Rough Material Stores thus enabling the flow of material supplies to be kept in one direction.

Facilities for handling material of a heavy or bulky character are provided by three travelling Electric Hoists (lifting capacity : two tons) which cover the entire area of the Goods Inwards, thus enabling goods to be unloaded direct from rail or Road Transport.

For Goods arriving by Road Transport entry is made to the Goods Inwards direct from the Main Service Road and Goods delivered by Rail are shunted by a Locomotive (of A.E.C. design and manufacture) on to the privatesiding skirting the Goods Inwards and Main Factory.

All incoming material is unloaded, checked and cleared from the Goods Inwards within 24 hours of receipt, together with the Goods Received Notes ; the latter are issued on a Lamson-Paragon Duplicating Machine.

ROUGH MATERIAL SUPPLIES

Receipt of Castings and Stampings.

Consignments of Rough Castings or Stampings are unloaded direct from Rail or Road Transport into scooter boxes and checked with Delivery or Advice Notes.

A GOODS RECEIVED NOTE, Form No. 02893/5/40, is then issued, copies of which are passed to Production Control, Laboratory, Inspection, Stores and Accounts Departments, one copy being retained by the Goods Inwards for reference purposes.

In the event of the material requiring a Laboratory Test, a red label is attached endorsed "N.P.L." (signifying "Not Passed

Laboratory ") and on no account must the material be moved until the label has been removed by the Laboratory indicating that the Test has been completed.

The View Room copy is placed in the scooter box with the material where it awaits inspection and approval by Inspection Department and Laboratory.

After inspection, the Material, if O.K., is passed to the Rough Stores (adjacent to the Machine Line where the job is to be machined) and the Goods Received Note (duly signed by Inspection and Laboratory) is passed to the Order Section for recording on the Master Record Card.

Material requiring pickling or sandblasting is unloaded direct on to the respective locations and dealt with as and when required.

Rejection of Rough Material.

All Rough Material rejected by the Inspection Department or Laboratory is passed to the Goods Outwards together with a copy of the REJECT LETTER for despatch to the supplier for replacement. Copies of the Reject Letter are issued to Inspection, Accounts and Order Section (P.C.D.).

Steel Bar, Tube, Angle, etc.

This class of material is passed direct to the steel stores where it is unloaded, weighed, checked and inspected in accordance with " Stores Routine " (see page 441).

Alloy Stick and Bar Material.

This material is unloaded, checked and weighed and a Goods Received Note issued. After inspection and approval by View Room and Laboratory the Goods Received Note is endorsed accordingly and the material passed to the Rough Stores together with the Goods Received Note which is signed by the Storekeeper and passed to the Order Section for recording on the Master Record Card.

FINISHED MATERIAL SUPPLIES

Receipt of Finished Material from Outside.

Finished Material is unloaded in close proximity to the Inspection Department where it is unpacked and placed direct on to the viewing tables ready for inspection.

After being checked with Advice or Delivery Notes, a GOODS RECEIVED NOTE, (Form No. 02993) is issued, copies of which are passed to Production Control (Order Section), Inspection, Laboratory, Stores and Accounts Departments. The Stores Section copy is retained with the consignment of goods where it awaits inspection by the viewer.

After the material has been inspected the Goods Received Note is O.K.'d by the Viewer and passed with the material to the Finished Stores where the material is deposited in the corresponding Stores Bin and the Goods Received Note, after being signed by the Storekeeper acknowledging receipt, is passed to the Order Section for recording on the Master Record Card.

Rejection and Return of Material to Supplier.

Finished Material rejected by the View Room or Laboratory is passed to the Goods Outwards from whence it is sent to the supplier for replacement together with a copy of the Reject Letter on which is stated the reason for rejection.

GOODS RECEIVED BY POST OR MAIL

All Parcel Mail is collected from the Mailing Department each morning by a Representative of the Goods Inwards. It is unpacked, checked with Delivery or Advice Notes and after inspection is passed to the corresponding Stores or destination.

Registered Parcel Post is signed for by the Goods Inwards Representative and after checking is personally handed to the consignee.

MATERIAL SENT OUTSIDE FOR REPAIR OR RE-CONDITIONING

This material is passed to Goods Inwards from the Department concerned, with full details of work required to be done. Upon receipt in Goods Inwards, a Purchase Requisition is issued giving full particulars of Part concerned, Operations Required, Quantity and Cost Allocation—When the Purchase Order has been placed on Supplier by P.A., a copy is passed to Goods Inwards authorising despatch of the Material, together with advice (E) Note to the Supplier concerned. Upon completion of the work, the material is received in Goods Inwards, a Goods Received (C) Note is issued in accordance with normal procedure and the material returned to Department from whence it was received.

OUTSIDE MACHINING WORK—DESPATCH AND RECEIPT OF MATERIAL AND TOOLS

Details of work to be sent outside for machining, are passed to Goods Inwards on an OUTSIDE MACHINING INSTRUCTION, (Form No. OM.2) on which details are given of Component concerned, Purchase Order Number, Quantity involved and particulars of operations to be done. The material is passed to Goods Outwards, checked for quantity and despatched to Suppliers concerned,

together with Tooling Eequipment and Advice (E) Note (Form 88423), a copy of which is passed to the Planning Section.

Upon receipt in Goods Inwards from Supplier after completion of work, the material is checked for quantity and passed to Inspection Department, together with Goods Received Note. After inspection, the material is passed to Finished Stores, or, if further work is required to be done, passed to Production Department concerned, together with the Job Card.

RETURN OF EMPTY CASES AND BARRELS

Cases containing goods delivered by Pickfords or Carter Paterson are returned by the same source. Empty cases received from Suppliers in locality or London area are collected by their own transport and delivered by A.E.C. Transport if in the vicinity. All other cases and containers are returned immediately they have been unpacked per G.W.R. (Goods). Empty barrels or drums are invariably collected by Suppliers own transport when delivering or by special arrangement. CONSIGNMENT NOTES (O) are issued, copies of which are passed to Supplier, Accounts Department and Carrier concerned.

CLAIMS AND DISPUTES (LOSS OR DAMAGE OF GOODS)

Claims for Goods lost during transit must be made within a period of 14 days of despatch, otherwise any such claims will be repudiated. All Advice Notes are, therefore, checked daily and if material is not received within 10 days from despatch, notification is passed both to Supplier and Carrier.

Notification of Goods received in a damaged condition by either Road, Rail or Post is immediately passed to Carrier (and Supplier) concerned (copy to Accounts Department) and goods laid out for inspection by their Representative.

Suppliers are notified on a circular letter (No. 8928) of any discrepancies or variations which are discovered after checking between goods advised and actually received.

When Goods are received without Advice or Delivery Notes, the Supplier concerned is notified accordingly by letter (No. 8298A) (Copy Accountant's Department) giving details of the Goods and Quantity received and the Purchase Order Number against which delivery has been recorded, and a TEMPORARY ADVICE NOTE (M.3016) issued and filed for reference.

CHECKING OF FREIGHT CHARGES

Rail Transport (Goods)

All accounts (Inwards and Outwards) for Rail Transport (Goods) are passed to Goods Inwards for scrutiny before payment is made.

The accounts are checked with Standard Railway Freight Charges and in cases where Rates are not in operation, arrangements are made with the Railway Company for such rates to be included in their Standard Charges.

All matters relating to the General Railway Classification of Goods are passed to Goods Inwards and, where necessary, referred to the Railway Clearing House in order that arrangements may be made by them to send a Representative to Southall and effect agreement. This is later confirmed at the current meeting of Railway Rates Tribunal and included in General Railway Classification of Goods.

Rail Transport (Passenger Train).

Where material is received by Passenger Train the A.E.C. is only liable for the extra cost over and above that which would normally be paid by Goods Train, and they have instructed Suppliers to forward by Passenger Train.

Invoices received including Passenger Train charges are first passed to Order Section for checking that the material was requested to be forwarded by Passenger. After agreement, the invoice is returned to Goods Inwards Department and the weight of the consignment is ascertained and checked with Railway scale of Charges. From this amount is deducted the cost of sending such consignment per Goods Train, and the amount of difference is then passed on Suppliers invoice.

In the event of non-agreement, the matter is taken up with Supplier by Goods Inwards staff.

Road Transport.

Goods are conveyed by Road Transport at Rates agreed upon with Road Transport Contractors after receipt of quotations. Invoices are checked against quotations before passing for payment.

STORES SECTION

Functions.

Receipt, Storage and Issue of Rough and Finished Material, Steel Bar and Tube, Sheet Metal, etc., for Production Requirements.

Finished Part Stores.

The Finished Part Stores is situated in the centre of the Main Factory and adjoins Production Control Department Central Office.

This Store is mainly concerned with storage of Finished Parts preparatory to their issue to the Production Departments for Assembly and Erection.

In this Store is also stocked "General" Service and maintenance material such as Brushes, Soaps, Clogs., etc., which are stocked on a maximum and minimum basis.

The Stores is sub-divided into various Units each being in the charge of a Section Storekeeper who is responsible for the Receipt, Storage and Issue of all material concerned with Units allocated to him, and also for the general cleanliness of his Section of Stores.

Receipt of Material.

Finished Material from Outside Suppliers is received from Goods Inwards via Inspection Department accompanied by a Goods Received Note "O.K.'d" by Viewer giving particulars of Part Number and Description of Component, Order Number, Quantity and Date Received. Finished Material from the Factory is received from the Production Departments accompanied by a Pass Forward Slip giving particulars as to Part Number, Quantity and Description, and is also "O.K.'d" by the Sectional Viewer.

Upon receipt in Finished Stores, the Section Storekeeper concerned checks the Goods actually received with the Goods Received Note, which he signs and passes to Main Stores office for recording purposes.

The Storekeeper then refers to his Shortage List to ascertain if the part is required for immediate issue.

Storage of Material.

If such is not the case, he will, after ensuring that each part is properly greased or protected against deterioration, place in Bin allocated until required for issue (See subsequent issues).

Issue of Material to Assembly Departments.

When material is required for issue to Assembly (in accordance with Production Schedule) the Chief Storekeeper applies to Specification Section for a set of Material Assembly Sheets.

These are supplied in the form of prints, and are marked up by Specification Section multiplying the quantity per chassis set by the total number of sets to be issued.

The Assembly Lists are then separated by the Chief Storekeeper and passed to each of his Section Storekeepers, in accordance with the Units for which they are responsible.

Each Section Storekeeper then proceeds to issue the material from the Stock Bins and load on to Assembly Trays until each item on his list is accounted for, grouping the components in sub-unit form.

As each item is drawn from stock, the Assembly Sheets are endorsed with the Quantity Issued, and if no Stock, are marked "N.S." and the Assembly Lists returned to Chief Storekeeper.

Shortage Lists.

Having issued from Stock all available material the Section Storekeeper compiles a SHORTAGE SHEET from the Assembly Lists of all items for which he has shortages or "No Stocks."

These lists are then handed to Chief Storekeeper for copies to be typed and issued to Order Section, Urge and Progress Sections, retaining one for his own use.

The Chief Storekeeper then collects all Assembly Sheets which are then passed to Order Section to be decarded and returned to Storekeeper for subsequent issues.

The whole of the material is then issued to the Assembly Section concerned.

In order that all concerned may be fully acquainted with the postion of all Material Issued to Assembly, the Chief Storekeeper issues in conjunction with Progress Section a Weekly Report giving particulars of all material actually on the Assembly Sections, and particulars of the material it is proposed to issue for the ensuing weeks.

Subsequent Issues.

After the main batch of material has been issued, all Subsequent Issues are dealt with by the Section Storekeeper immediately upon receipt in Finished Stores, advising Order Section daily on "PAID OFF TO-DAY" Sheets, giving particulars of Material Issued and Unit and Batch concerned. This information is decarded by the Order Clerk, and the roneo filed, the material being issued to the Assembly Shop concerned.

Material Rejected from Fitters.

In cases where material is rejected by Fitters after issue from Stores, the Assembly Foreman issues a Reject Note in triplicate and sends the rejected material together with two copies of Reject Note to Main View Room, retaining one copy for reference.

After inspection of the Rejected Material, the View Room report on the back of the Reject Note, one copy of which is sent to Stores with the necessary instructions for replacement.

If the material is available in Stock, the Sectional Storekeeper issues replacements immediately, and hands the Reject Note to Order Section for decarding, after which it is sent to Cost Office.

If no Stock, the item is added to existing shortage list for action by the Assembly Progress Man concerned.

Stocks Not Moving.

In order that material is not retained in stock for undue periods without movement, thereby deteriorating, or possibly becoming obsolete or redundant, Section Storekeepers are required to submit periodically a list of material which has been in stock for a period of three months and over without movement.

This list is handed to Stores Auditor for investigation. It is returned to Chief Storekeeper with disposal instructions for immediate action.

Receipt, Allocation and Despatch of Spares Material.

Finished Material designated for Spares (L.T. and A.E.C.) is passed to the Finished Part Stores for allocation and despatch.

All Pass Forward Slips and Goods Received Notes are passed to the Order Clerk concerned and endorsed by him with the quantity allocated to Spares in accordance with the Factory Schedule.

These documents are returned to the Storekeeper, who is responsible for ensuring that the material is passed to the Stores Section responsible for the despatch of Spares Material.

Material for A.E.C. spares is passed to that Stores direct, and Material for London Transport is collected daily by their own road transport.

In each case a Delivery Note is issued and accompanies the material.

Material Withdrawn from Assembly Departments to Meet Urgent Spares Demands.

In certain cases where, due to unforeseen circumstances, it is not possible to supply material to meet sudden and urgent demands for Spares, the material, if available, is withdrawn from the Assembly Departments.

A RETURN TO STORES NOTE (M.1039) is issued after investigation by the Chief Progress Man, and passed to the Assembly Foreman concerned authorising the release of the material from his Section.

The Spares Progress Man concerned is responsible for ensuring that the material is passed to the Spares Stores via the Finished Part Stores, together with the Delivery Note.

The Return to Stores Note is passed to the Order Section for recording, and the item added to the current shortage sheet for action by the Progress Section and subsequent replacement.

ROUGH MATERIAL STORE

Functions.

Receipt, Storage and Issue of Rough Materials.

The Rough Material Store adjoins the Goods Inwards and extends the whole length of the Main Machine Shops, thus enabling

material to pass through the Production Departments without retrogression.

This Store is under the control of the Chief Storekeeper and is mainly concerned with receipt, Custody and Issue of Castings, Stampings, Forgings, Pressings, Alloy Bar and Cored Stick.

CASTINGS, STAMPINGS, FORGINGS, ETC.

Receipt of Rough Material.

Consignments of this class of material are passed to the Rough Material Stores from Goods Inwards together with the Goods Received Note (No. 02993). Copies of this document are passed to Accounts, Laboratory, View Room and Production Control Department.

Upon receipt into Stores, the Storekeeper checks the material with the Goods Received Note which he endorses with his signature indicating receipt.

The Material is stored in bins adjacent to the Machine Line on which the work is to be machined, and the Goods Received Note passed to the Order and Material Control Section for recording on Master Record Cards.

Samples for Initial Supplies.

Before bulk supplies are delivered off any new Dies in the case of Stampings or new Patterns in the case of Castings, Suppliers always submit samples for approval; these, when received, are booked in by Goods Inwards Department, on Goods Received Note (No. 02993) endorsed "SAMPLE FOR APPROVAL" and passed to Inspection Department, who check for dimensions only and forward report on same to Suppliers. Samples approved are passed into Rough Stores together with Goods Received Note. Samples rejected are returned to Suppliers with Inspection Department's report and Goods Received Note only is sent to Rough Stores marked "rejected."

Issue of Rough Material to Production Departments.

Rough material is issued to the Production Departments on presentation to the Storekeeper (by the Progress Section) of the Material Requisition (Notice of Issue). The material is issued to the Production Department indicated on the Material Requisition, which is endorsed by the recipient and returned to the Storekeeper.

The Material Requisition with the quantity issued filled in is signed by the Storekeeper and passed to the Order and Material Control Section for recording on Master Record Cards. The "Notice of Issue" copy is passed to Cost Office.

Alloy Bar and Cored Stick.

This class of Material is also passed to the Rough Material Stores

from the Goods Inwards accompanied by Goods Received Note (No. 02993).

After being checked by the Storekeeper, the material is accepted into stock and the Goods Received Note endorsed by the Storekeeper and passed to the Order and Urge Section for recording on Master Record Cards.

The Issue of this class of material to the Production Departments is authorised on presentation of the Material Requisition to the Storekeeper, in accordance with normal procedure.

SHEET METAL STORES

Functions.

Receipt, Storage and Issue of Sheet Metal.

The Sheet Metal Store is situated in the centre of the main factory and adjoins the Sheet Metal (Tinsmiths) Shop, and is under the control of the Chief Storekeeper.

Material is stored in horizontal racks, in accordance with specifications and dimensions.

Receipt of Material.

All Sheet Metal is received via Goods Inwards accompanied by Goods Received Note (Form No. 02993/5/40), copies of which are issued to Laboratory, Cost Office, Accounts, Order and Urge Sections.

Upon receipt, the material is unpacked by the Storekeeper, and after checking with the Goods Received Note, is transferred direct to Racks.

The Goods Received Note is signed by the storekeeper and recorded on Master Record Cards. Copies of the Goods Received Note are passed to Accounts, Laboratory, View Room and Production Control Department.

Issue of Material.

There are three methods of the issue of Sheet Metal to the Shops :

1. By Material Requistion (Form No. M.02601). This applies to all Production jobs with the exception of Bonnet and Petrol Tank Details.

2. By instructions contained in Manifold Note issued by Order Clerk responsible for Sheet Metal. This applies to Bonnet and Petrol Tank Material.

3. By small blue Material Requisition (Form No. ST8021), used for jobs of a small general character, other than production.

Immediately after the issue of material, the weights are endorsed on the Material Requisition and details recorded on Master Record Card.

STEEL STORES

Functions.

Receipt, Recording and Issue of Steel Bar, Tube, Angle, etc.

The Bar Material Store adjoins the Bar Machine Shop, and is under the control of the Chief Storekeeper. Material is unloaded direct from Road Transport, and also from Rail Transport from A.E.C. private line which extends the whole length of the Steel Stores.

Material is stored in horizontal racks in accordance with Specification and Size.

Receipt of Material.

Upon receipt of a consignment of raw material in Steel Stores, it is checked by Storekeeper with Supplier's Delivery Note, and Card Records to ensure it complies with sizes and weights mentioned thereon.

A Goods Received Note, (Form ST.3012), is then issued by Steel Stores Clerk, in which is stated particulars of Date of Receipt, Order Number, Part Number (of steel), Supplier, Description and Size of Material, Quantity (in bars), and Weight.

Copies of this Delivery Note are sent to Accounts Department, Order and Urge Section, Laboratory and Inspection Department.

Laboratory, Inspection and Test.

Under no circumstances is material accepted into Steel Stores Stock unless it has satisfactorily passed Laboratory and Inspection Test, and until such time as the necessary authority is received, a red label is affixed to the Material endorsed "N.P.L." signifying "Not Passed Laboratory," (Form No. ST.40255.)

Upon receipt in the Laboratory of their copy of Goods Received Note, the information contained thereon is checked with Laboratory Records to ensure it complies with the Material Specification and if satisfactory the Laboratory endorse the Goods Received Note with rubber stamp "Passed into Stock," stating date and affixing signature, returning Goods Note to Steel Stores.

The Viewer then subjects the Material to Brinell Tests and makes the necessary inspection for Cracks, Flaws or any other defects and, if satisfactory, endorses the Goods Note accordingly. The Material Specification Symbol and Size is stamped by Inspection Department on the ends of each bar.

The Material is then finally accepted into Stock and delivery recorded on Stock Card, (Form No. ST.0439.)

Should it be necessary for the Laboratory to effect a Physical Test, they endorse their copy of Goods Received Note with rubber stamp "Sample Required for Laboratory Test" and return same to Steel Stores with requisition attached (Form No. ST.8021) cover-

ing amount of Material required which is cut off and returned to Laboratory for Test purposes with Goods Received Note.

If, after Test, the Material proves satisfactory, the Goods Received Note is endorsed accordingly by Laboratory and passed to Steel Stores authorising receipt.

Should the material prove unsatisfactory after Laboratory Test, a report giving particulars of rejection, is issued to Chief Inspector, who immediately advises the Supplier by a Reject Letter, (Form No. M.3702a), copy of which is passed via Steel Stores to Order Section for recording purposes, the material being returned to Supplier for replacement.

Issue of Material to Shops.

Issue of Steel Bar, Tube or Angle is authorised in the case of Production jobs on presentation to Steel Stores of Material Requisition by Machine Line of Section concerned, stating particulars of Sizes and Specification of Material required, Length per part, and particulars of the job for which it is required.

The Storekeeper multiplies the length per part by total quantity per batch, and issues a sufficient quantity (making due allowance for parting off) covering the batch, which is weighed and particulars of weight entered on Rough Material Requisition.

The Material is then issued to Machine Lines or Section indicated on Material Requisition, Stock Balance reduced accordingly, and the Rough Material Requisition passed to Cost Office via Main Stores Office.

Issues other than for Production are authorised by a small Requisition, (Form No. ST.8021), mainly received from Millwrights, Tool Room or Laboratory, the same procedure being followed as above.

Stocks Not Moving.

As in the case of all Sections of Stores, the Steel Storekeeper is required to submit periodically a list of Steel for which there has been no demand, extending over a period of three months.

These items are dealt with by Stores Auditor and instructions issued for disposal or otherwise.

Parting Off Machines.

For the purpose of parting off to length Steel Tube, Bar and Angle, the following machines are attached to the Steel Stores under the control of Chief Storekeeper :

One Hellier Cold Saw.
Two Acme Parting Off Machines.
One Guillotine (H. Pells).
Two Russell Automatic Cold Saws.

OIL AND GENERAL STORE

Functions.

Receipt, Storage and Issue of Oils, Greases, etc.,

In this store is stocked all Engine Oils, Gear Oils, Cutting Oils, Paints, Soda, Casehardening Compounds, and materials for Plating Shop, and is under the supervision of the Chief Storekeeper.

Requisitioning Material on Purchasing Agent.

This class of material is ordered on a consumption basis, a Daily List of items below minimum stock being submitted by the Storekeeper to the Chief Order Clerk. A Purchase Requisition is issued covering the quantity required to bring stocks to maximum and is passed to the Purchasing Agent for issue of Purchase Order.

Recording Order and Stock Details.

Details of all movement of this material, including Purchase Requisition and Order Details, Receipts, Issues and Stock Balances, are recorded on Master Record Cards in the Order and Urge Section.

Receipt of Material.

Fuel Oil, Received in bulk by Rail Transport in Tank Wagons and weighed upon receipt on Weighbridge by Goods Inwards Checker who, after checking with the Advice Note, issues a Goods Received Note (Red) (Form No. 02992), a copy of which is passed to the Storekeeper.

Upon arrival in the Oil Stores the Fuel Oil is pumped into the Storage Tank (which is of 80 tons capacity) adjacent to the Casehardening Department. The Goods Received Note is signed by Storekeeper and passed to Order Section for recording.

Creosote Pitch, is received in bulk by Road Transport in Tank Wagons and weighed upon receipt on Weighbridge by Goods Inwards Checker who, after checking with Advice Note, issues a Goods Received Note (Red), a copy of which is passed to the Storekeeper. Upon arrival in Oil Stores, the Creosote Pitch is pumped into the Storage Tank (which is of 90 tons capacity) adjoining the Boiler House. The Goods Received Note is signed by Storekeeper and passed to Order Section for recording on Master Record Cards

Petrol, Gas Oil, Dynamo Oil, Engine Oil.

This is received in bulk by Road Transport in Tank Wagons and checked by Dip Rod in the Goods Inwards. After being checked with Advice Notes, a Goods Received Note (Red) is issued and passed to Storekeeper who is responsible for ensuring storage in the respective Storage Tanks. The Goods Received Note is signed by Storekeeper and passed to Order Section for recording on the Master Record Cards.

This class of material is stored in the following Storage Tanks :

	Capacity	
Petrol		
General Tank ...	2000 gall.	for Production use.
Expl. Dept. Tank	1000 gall.	for Exptl. purposes.
No. 1 Spares Tank	2000 gall.	for General purposes (Grade C).
No. 2 Spares Tank	500 gall.	for Pool Cars (Grade A).
Service Station ...	500 gall.	for General use.
Engine Oil.		
Test House	2000 gall.	for Testing Engines.
Steel Stores ...	1000 gall.	Feed for Test House.
15/16 Bay	1500 gall.	Feed for Test House.
Assembly Table ...	1000 gall.	Feed for Test House.
Dynamo Oil.		
Goods Inwards ...	500 gall.	General use.
Goods Inwards ...	1000 gall.	General use.
Steel Stores ...	500 gall.	General use.
Swarf House... ...	450 gall.	General use.
Gas Oil.		
Test House	2000 gall.	Engine Test.
Rail Car Shed ...	400 gall.	Rail Cars and A.R.P.
Expl. Dept. ...	300 gall.	Testing Engines.

All other Oils and Greases are received in barrels and stocked in the Oil Stores or on the adjacent field.

Acetylene and Oxygen Gases are stocked in the Goods Inwards in special racks.

Issue of Material.

In the case of Fuel Oil for Casehardening Furnaces and Heating Plant, also Gas Oil and Engine Oil for Test House, a Requisition is passed by the respective Foremen, covering weekly consumption.

For the issue of Petrol, a Requisition is passed by the respective Foremen, covering daily consumption.

These Requisitions are endorsed with the respective Chassis or Truck Number.

All other materials are issued from this sub-stores as required, on presentation to Storekeeper of a Requisition which is passed to Order Section for recording on Master Records and thence to Cost Office.

ASSIGNED STORES

Functions.

Receipt, Storage and Issue of Material.

The Assigned Store is situated in the centre of the Factory, between Assembly and Machine Lines, and is used as a sub-store for the storage

of Material assigned to Assembly Shops until required for assembly.

To prevent loss or pilferage, the Assigned Store is enclosed by Wire Fence and is under the control of Chief Storekeeper.

To this Store is also consigned Material issued by Main Stores on Assembly Trays, and other material requiring large storage space, such as Axle Cases, Cylinder Blocks, and Heads, Worm Cases, etc., where it is deposited until required for Assembly and issued at the request of the Assembly Foreman.

A record is kept of Material received direct from Machine Lines, details of which are recorded from Pass Forward Slip issued by Sectional Viewer.

After particulars have been recorded the Pass Forward Slip is passed to Order Section for entry on the Main Record.

The issue of material to Assembly Shops (other than that already issued on Assembly Trays) is also recorded from Assembly Lists which are passed to Order Section for recording on Main Records.

Special care is taken to ensure that all bright surfaces are treated with a rust preventative which is applied with a Spray Gun.

TYRE AND WHEEL STORES

Functions.

Requisitioning, Receiving, Recording, Storing and Issuing Tyres and Wheels for Production and Service Requirements, Preparation of Delivery Schedules, Urging Supplies and Correspondence in connection therewith.

The Wheel and Tyre Store is situated in close proximity to the Chassis Erection Platform and is under the control of the Chief Storekeeper.

Owing to the rigid control exercised by the Ministry of Supply over Tyre Supplies, strict observance to the following procedure is essential.

Tyres for Ministry of Supply Contracts.

Tyres for Ministry of Supply Contracts are delivered from the various manufacturers against instructions from the Ministry of Supply.

Delivery of tyres is controlled by the issue to Ministry of Supply two months in advance, of a Delivery Schedule (Form No. T.1) which is compiled each month in accordance with requirements indicated on the Production Schedule. A Statement (Allocation Order Form No. 75879-1), is received from the Ministry of Supply on the first day of each month, giving details of the dates upon which deliveries will be made and the quantities to be supplied by each respective Tyre Manufacturer.

This statement is checked with the Production Schedule to ensure

that the delivery arrangements conform with Production requirements and contact is maintained with the manufacturers to ensure that these arrangements are adhered to.

When tyres are to be delivered from American sources of supply (Lease-Lend) information is given on the Ministry of Supply statement to that effect and contact is maintained with the Distributing Centre, Ministry of Supply, Stoke-on-Trent, in order that delivery arrangements are fulfilled.

All Tyres, with the exception of those from American sources of supply, are delivered complete with Disc Wheels from the various Tyre Manufacturers by Road Transport.

American Tyres are delivered without Disc Wheels, which are fitted by the Assembly Section as and when required for production, a Factory Order being issued to cover all work in this connection, chargeable to the respective Production Programme.

Separate Advice Notes are received for Tyres and Wheels, on which are given details of Type, Size, Quantity and Ministry of Supply Allocation Order Number.

In the case of Tyres, each consignment is also accompanied by two copies of the C.I.M. Inspection Notes. (Form No. M.O.S.99.)

Upon receipt in the Tyre Stores, the consignment is checked with the Advice Notes and after examination a Goods Received Note, (Form No. 3012), is issued, a copy of which is passed to Accounts Department only. The consignment is accepted into stock, the delivery being recorded on the Stock Card and the Stock balance adjusted accordingly.

The C.I.M. Inspection Notes are retained by the Storekeeper pending receipt of a third copy by post from the Tyre Manufacturer concerned and returned after being endorsed with the Contract Number and Date of Receipt and signature of the Superintendent Production Control. The two remaining copies are retained by the Storekeeper pending completion of the contract, when they are checked by the C.I.M. to confirm that the contract has been completed, and subsequently filed.

Disc Wheels for Ministry of Supply Contracts.

Upon initiation of a Manufacturing Programme due notification, in the form of an Ormig Instruction, is passed to the Tyre Storekeeper, who prepares a Purchase Requisition covering the quantity of Disc Wheels involved, on which is indicated the Part Number, Type and Size, Contract Number, Programme Symbol and approximate delivery requirements. The Purchasing Agent issues a Purchase Order to the Wheel Manufacturer concerned, a copy of which is passed to the Tyre Storekeeper for recording details on the Stock Card. (Form No. 0439.)

A Monthly Statement (Form No. T.2), is prepared showing the weekly requirements (covering a period of three months) and submitted to the Ministry of Supply who ensure that delivery requirements are maintained.

Immediately upon receipt from the Ministry of Supply of the monthly Tyre Allocation Forms, on which information is given in regard to the Tyre Manufacturer concerned and the quantity they are to supply, arrangements are made for the corresponding quantity of Disc Wheels to be available to the Tyre Manufacturers for fitting before delivery to Southall.

The Disc Wheel Manufacturers are notified as to where supplies of Wheels are to be despatched and contact is maintained to ensure that these instructions are complied with.

In regard to American Tyres, Disc Wheel Manufacturers are advised in order that a consignment of Disc Wheels may be diverted to the A.E.C. for fitment at Southall.

Issue of Wheels and Tyres to the Production Department.

Disc Wheels fitted with Tyres are issued to the Production Department daily, in accordance with Chassis Erection Schedule and are checked against each chassis to ensure that the correct types and position of Tyres are fitted to the various models.

Details are recorded of all Tyres Issued and the Chassis Numbers to which they have been fitted.

The Stock Cards are adjusted in accordance with the Daily Issues against which is also recorded the respective Programme Symbol.

Spares and Service Requirements.

All Tyre Replacements are governed by the Rubber Control Order (1942) Section 4, which also applies to re-moulds and are only obtainable from an authorised Tyre Dealer on presentation of the necessary certificate.

All requests for new Tubes or Tyres or re-moulds are centralised in the Superintendent of Sales Inspection who is responsible for all transactions in this connection.

Rejects.

When Wheels and/or Tyres are found after inspection to be damaged or faulty, the Inspection Department is notified in writing stating the Wheel or Tyre Number, Order Number, Part Number and reason for rejection. The Inspection Department issue an Inspection Note to the manufacturer concerned, a copy of which is passed to the Goods Outwards who arrange for collection from the Tyre Stores and transport to the manufacturer concerned. In the case of Dunlop's, rejected Wheels and Tyres are retained in the Tyre Stores until a sufficient quantity has accumulated to warrant

collection by Dunlop's transport. When Tyres from American sources of supply are rejected, they are inspected by the C.I.M. and a report submitted to the Ministry of Supply (T.T.2) London, from whom instructions are received in regard to the manufacturer to whom the Tyres are to be consigned for correction. Details of all rejects are recorded on the stock cards.

When Wheels or Tyres are damaged at the A.E.C. or Coachbuilders, a Rejection Note (Form No. 8918), is issued by the Department concerned endorsed with the Department or Programme to whom the cost is chargeable. One copy of the Reject Note is passed to the Tyre Storekeeper with the Wheel or Tyre and one to the Goods Outward who issue a Requisition on the Purchasing Agent, authorising the issue of a Purchase Order on the manufacturer concerned. A copy of this order is passed to the Goods Outwards who arrange collection from the Tyre Stores and despatch to the manufacturer, and a copy is passed to the Tyre Storekeeper for recording particulars on the Stock Record Cards.

SUB-STORE

Functions.

Receipt, Custody and Issue of Material Surplus to immediate requirements (Finished Parts, Part Machined Components and Steel bar).

To this Store is consigned material which, due to existing difficulties in regard to supply, it is necessary to accept in excess of immediate scheduled production requirements.

This material constitutes : Rough Material Supplies (Castings and Stampings) ex. U.S.A., Supplies of machined components from U.S.A., proprietory and "General" stock items, partly machined material from Production Departments and Outside Machining Contractors, Steel Bar and Tube.

Rough Material Supplies ex. U.S.A.

Rough Material (Castings and Stampings) from American sources of supply will, if not required for immediate issue, after investigation by the Planning Section, be passed to this Store and the Goods Received Note endorsed accordingly and information recorded on the Master Record Cards.

Machined Components ex. U.S.A.

This material, if not required for immediate Spares or Production requirements, will, after investigation by the Planning Section, be passed to this Store until required for issue.

These parts will only be issued on the instruction of the Planning Section as and when needed to fulfil Production or Spares requirements.

The Receipt and Issue of these components will be dealt with in accordance with normal procedure and the Goods Received Note must be endorsed "Sub-Stores" before being passed to Order Section for recording on the Master Records.

Proprietory and "General" Stock.

Upon receipt of this material, if there is no available storage space in the Finished Main Stores, the consignment, on the instruction of the Chief Storekeeper, must be passed to the Sub-Stores and the Goods Received Note endorsed accordingly before passing to the Order and Urge Section for recording.

Upon arrival at the Sub-Stores, the Storekeeper, before transferring the material to the bin, will ensure that a label is attached bearing the date of receipt, to ensure that the material which has been in stock for the longest period will be issued first.

When the stocks in the Finished Main Stores require replenishing, the Chief Storekeeper will make arrangements for the immediate transfer of stock from the Sub-Store, and advise the Order and Urge Section of the transfer in order that the records may be adjusted accordingly.

Partly Machined Material ex. Production Departments.

This is mainly comprised of material issued for Production Programmes on which work has been temporarily suspended, and to relieve the congestion in the Production Departments, is transferred to the Sub-Stores together with a Pass Forward Slip stating the batch number, operations completed and quantities.

The Pass Forward Slip is endorsed "Sub-Store" and after receipt in this Store is passed to the Order and Urge Section for recording purposes. The Job Card is returned via the Order and Urge Section to the Planning Section.

When material is subsequently required for re-issue to the Production Departments for completion of the remaining operations, indication will be given by Planning Section to this effect on the Factory Schedule. Material Requisitions, Job Cards and Job Labels will be issued in accordance with normal procedure.

Partly Machined Material ex. Outside Machining Contractors.

Upon receipt and after inspection, the Planning Section will arrange for this material, if not required for immediate issue, to be passed to the Sub-Stores, to which must be securely attached a Job Label endorsed with the Part Number, Quantity, Operations completed, Contractor concerned and Date received.

The Goods Received Note will be endorsed "Sub-Stores" and passed to the Order and Urge Section for recording.

This material will be issued to the Production Departments for completion of operations as and when required for production, as indicated on Factory Schedule issued by Planning Section.

Steel Bar.

Racks are provided in the Sub-Store for the storage of Bar Material not immediately required for Production and for which there is no available storage space in the Main Steel Stores.

The Goods Received Notes are endorsed by the Storekeeper "Sub-Stores" and passed to Order and Urge Section for recording.

The method of receipt, storage and issue of all material in the Sub-Stores is to conform with the normal standard procedure and all movements of material in this store must be recorded on the Master Record Cards, which must clearly indicate that the material has been passed to the Sub-Stores.

Ground or highly finished surfaces must be treated with rust preventative, and all external threads fitted with cardboard ferrules to prevent damage.

UNIT STORES

Functions.

Receipt, Custody and Issue of Main Units, Trolleybus Equipment and Proprietory Units.

The Unit Store is situated in close proximity to the Chassis Erection Platform and is normally used for the Storage of Main Chassis Units and Trolleybus Equipment prior to Issue to Assembly Section.

Under present (war-time) conditions, the whole of the Unit Production is either being incorporated directly into chassis or diverted to meet urgent war demands for Spares and the erection of trolleybus chassis has been suspended entirely.

This Store is, therefore, at present being used for the storage of various proprietory units such as Winch Gear, Lockheed Equipment, etc. (which, due to production difficulties, are received in advance of actual requirements) and are issued as and when required to the Assembly Departments for incorporating in chassis.

These parts are issued on Assembly Sheets and "Paid-off To-Day" Sheets and details of each issue are recorded from these documents on the Master Record Card in the Stores Office.

PROGRESS SECTION

Functions.

Routing of Work in Progress in accordance with Factory Schedules, Liason with Planning Section and Manufacturing Departments, Co-ordination of Material Supplies to meet Production and Spares Requirements, Maintenance of Unit Assembly and Chassis Erection in accordance with Production Schedules.

The primary function of the Progress Section is to ensure by physical effort that a correct and regular flow of material is maintained through the Manufacturing Departments to the assembly and Erecting Departments in accordance with a pre-arranged manufacturing schedule determined by the Planning Section.

Progress effort is directed towards three separate phases of manufacturing activities :

Machine Lines
Assembly Lines
Production of Spare Parts

and for this purpose Progress Men are allocated to the various manufacturing and assembly sections, each having his own separate functions and responsibilities.

CONTROL OF WORK IN PROGRESS, MACHINE LINES

The foremost duty of a progress man attached to the machine lines is to ensure that all machines on the sections to which he is attached are kept continually in operation on parts necessary for maintaining the production programme.

Progress men allocated to the machine lines operate mainly from the job cards, and it is their responsibility, in conjunction with the section foreman, to ensure that all operations on each batch of work are commenced during the week indicated against each operation on this card.

In cases of special urgency the job card is supplemented by priority No. 1 lists and shortages lists, etc., compiled by the progress section, but every effort is made to discourage the issue of such lists in order that progress effort may be concentrated on maintaining the rate of manufacture as indicated on the job cards.

Issue of Rough Material to Machine Lines.

The issue of rough material to the machine lines is controlled by the section progress man, and is governed in the first instance by the starting date for the first operation (as indicated by the batch symbol) and the amount of material already issued or allocated to the various machine types.

The Material Requisitions, Job Cards and Labels are issued to the Section Progress Man by the Planning Section shortly before the week in which first operations are due to commence, and if the material is required for immediate issue the Section Progress Man passes the Material Requisition and Job Label to the Storekeeper in charge of Rough Stores, authorising the issue of the necessary material, the Job Card being passed to the Shop Clerk for filing under the Machine Symbol and Part Number.

If the material is not required for immediate issue, the Material Requisition, Job Card and Work Label are retained by the Section Progress Man and filed in sequence of Machine Type and Part Number in a separate box until required.

A list of all Material Requisitions issued to the Progress Section is passed by the Planning Section to the Chief Storekeeper for information, giving details of Part Number, Description of Job, Quantity, Batch Symbol and the Machine Line to which the material is to beissued.

Allocation of Work to Machine Lines.

When allocating the next job to be put into operation, the Progress Man first refers to the Priority No. 1 lists and Shortage Lists to determine whether any jobs mentioned on the lists require priority, but failing this, the Job Card is referred to and a batch of work selected which is farthest behind the date scheduled on the Job Card against the operation concerned.

Having selected the batch of work which is to be put into operation, the Progress Man notifies the Section Foreman who hands the operator the Job Label giving particulars of the Batch Number, Part Number and Quantity, authorising the issue by the Shop Clerk of a JOB CHANGE TICKET, Form No. ST.026) (Fig. 25).

The Shop Clerk refers to the Job Card for details, issues the Job Change Ticket to the operator, and stamps against the operation on the Job Card the date started. The operator then clocks on the Job Change Ticket and places it in a box from whence it is collected periodically and recorded by the Central Time Office on a Master Record Card.

Upon completion of all the operations for which the Section is responsible, the Progress Man instructs the Transport Labourer to pass the batch of work to the Section Viewer together with the Job Card and Work Label.

The Section Viewer, after inspecting the batch of work, endorses the Job Card with the quantity O.K., Rejected or Scrapped, also with his symbol, and if further operations are required in other departments, places on the batch of work a TRANSPORT LABEL, Form No. 7749, together with the Work Label and Job Card ready for transport to the department concerned.

Upon completion of all operations called for on the Process Layout, the job is passed to the Section Viewer by the Transport Labourer, together with the Work Label and Job Card.

After inspection, the Viewer endorses the Job Card with the quantity O.K., Rejected or Scrapped, also with his symbol, and issues a PASS FORWARD SLIP, Form No. 30191, giving full particulars of the Batch Number, Part Number and quantity passed forward, and passes the batch of work to the Finished Stores together with

all the documents. The Job Card is passed to the Planning Section for scrutiny, where it is filed for a period of one month. The Pass Forward Slip is passed to the Order Section for recording on the Master Record Card and subsequently filed.

It is the responsibility of the Section Progress Man to ensure that all work is cleared from his section upon completion and passed, after inspection by the Section Viewer, to the Section concerned in the next operation, or, in the case of completed work, to the Finished Stores, together with the Job Card and Pass Forward Slip.

Operations Overdue.

A periodical report is compiled from the Job Cards by the Section Progress Man on an OPERATIONS OVERDUE REPORT, Form No. 00.1, in which is stated particulars of all batches of work behind schedule showing the actual operations overdue (indicated by the machine symbol) under the week in which they should have been started. Copies of this list are circulated to all Production Supervision and also to the Planning Section for investigating.

Plant Breakdown, Jig and Tool Holdup, etc.

It is the responsibility of Section Progress Men to report all cases of breakdown of plant, Jig and Tool delays and other matters retarding production to the Chief Progress Man in order that effective action may be taken by the Department responsible to overcome the trouble.

Non-Standard or Special Parts.

Lists of all parts of a non-standard or special character required for incorporation into chassis are compiled from D.O. Lists on FACTORY SHORTAGE SHEETS.

On these lists information is given in regard to Part Number and Description of Components, Quantity Required, Delivery Dates and Rate, also Production Departments and Operations concerned.

A special Progress Man is detailed to progress these parts through the Production Departments.

Alterations to Design—Progress Action.

Copies of Drawing Office Alteration Notes are passed by the Specification Section to the Progress Section by whom details are recorded in regard to the Alteration Note Number and Date Received. The Alteration Note is then passed to the Order Section for inserting against each item details of Work in Progress and Finished Stocks. The Alteration Note is then returned to the Progress Section and details issued to all Progress Men concerned for respective action. An Extra Expense Order covering the work necessary to bring the alteration into effect is issued by the Inspection Department.

MAN NO. 2347	MACHINE NO. SLAB
NEW JOB.	
TIME STARTED 1-30 P.M.	FOREMAN'S SIGNATURE .....
	OLD JOB.
PART NO. A14238	PART NO. A14238
BATCH W.R.47/4	BATCH WRV. 19/28
QUANTITY 60	NO. FINISHED 124
OPERATION 15	OPERATION 15
TIME LIMIT 1½ MIN.	TIME LIMIT 1½ MIN
TIME TAKEN / TIME ALLOWED	OVERTIME: Mon / Tue / Wed / Thur / Fri / Sat / Sun
IMPORTANT P.T.O.	

Front

JOB CHANGE TICKET

HOLD HERE

No.

THIS SIDE OUT. 10470

IMPORTANT.

This Ticket must be made out by the Foreman and handed to Operator whenever a Job is changed.

Operator must immediately Clock Ticket and place in Box provided.

All time worked between clocking on one Job and clocking on the next Job will be charged to the Job first clocked on.

ST. 0260 2/43

Back

Fig. 25

The Section Progress Man is responsible for ensuring that the necessary work is completed to effect the Alteration and the Material returned to the source of issue.

A statement is issued periodically by the Inspection Department giving details of Design Alterations which have not been effected and the reason thereof. Copies of this statement are circulated to Chairman and Managing Director, Works Manager, Purchasing Agent, General Manager (Sales), Drawing Office, Production Department and Production Control Department.

Disputes—Target Time Allowance.

Progress Men are not allowed to enter into any discussion or dispute in connection with Target Time Allowances, this matter being fully provided for by the issue of a Target Investigation Request to the Chief Process and Rate-setting Engineer by the Section Foreman and in no circumstances must the job be stopped or broken down on this pretext as the investigation can only be made whilst the job is in operation.

Control of Work in Progress—Assembly Lines.

Progress Men allocated to the Assembly Lines are mainly concerned with synchronising assembly of Units required for erection of Chassis in accordance with the CHASSIS BUILDING INSTRUCTION, Form No. CB.1.1. This list is compiled by the Progress Section from the Production Schedule and indicates the Quantity, Type and Building Sequence of chassis due for erection during the ensuing two weeks. Copies of this list are circulated to Production Supervision and all Departments concerned.

Issue of Assembly Material from Stores.

From the Chassis Building Instruction a weekly statement is prepared by the Progress Section showing the position in regard to to quantity built and outstanding on the various Production Programmes and also indicates particulars of material required to be issued from the Finished Stores to meet assembly requirements (covering a period of 3/4 weeks). Copies of this list are issued to Chief Storekeeper and all sections of Production Control Department concerned.

When a batch of material is issued from the Finished Stores to the Assembly Sections, a SHORTAGE LIST, Form No. SS.1, is prepared by the Storekeeper of all parts required to complete the issue for which stocks are not available. A copy of this list is passed to the Assembly Progress Men, who maintain close contact with the Machine Line Progress Men, to ensure all shortages are cleared before a hold-up occurs in assembly.

All " Bought Out " items appearing on this list are closely watched and sufficient warning is given to the Material Control Section to enable immediate and effective action to be taken.

PROGRESSION OF SPARES MATERIAL

Spares material of standard or current type is included in production batches, a proportionate quantity being allocated to Spares by the Planning Section when compiling the Factory Schedule, and the quantity allocated is indicated on each Job Card when spares material is affected.

Owing to a general tendency to give preferential treatment to production material, to the detriment of spares material of a non-standard character (due principally to the fact that such material is usually of an uneconomical batch size) it has been found necessary to form a small group of Progress Men who are held responsible for the supply of spare parts for London Transport and A.E.C. Spare Parts Stores.

These men are not attached to any particular section of the Production Departments, but have access to all sections and departments where Spares material is being produced, and operate from special urge lists compiled for that purpose.

All Spares Orders are passed to the Order Section in order that details may be recorded on the Stores Master Card. This card is then passed to the Planning Section for scheduling, and on items common to current production a proportion of each batch of work is allocated to the Spares Department, after taking into consideration the delivery date and rate required for such spares.

A list of all spares outstanding over a period of three months is periodically compiled from the Master Record Card, and copies of this list are circulated to all machine line Progress Men for special action to be taken.

When each batch of finished material is delivered to Stores, the quantity allocated to Spares as indicated on the Factory Schedule is recorded on the Pass Forward Slip by the Order Clerk and the material passed to Spares Department with the Advice Note.

In cases where material is not common to standard production, these items are scheduled by the Planning Section in accordance with delivery requirements and availability of material supplies.

Special Urge List (A.E.C. Spares).

Lists are compiled from various urge lists and correspondence received from the Spares Department, and a copy of this list, on which is indicated the delivery promises which have been given for each item, is passed to the Progress Man allocated to the Spares for personal urge.

PROGRESS REPORT.

SECTION. BF/PQ/GR. CHASSIS TYPE 0854 - PROG. X.G. Date Issued:- 11.6.43.

POSITION AS AT 7.6.43.

The following parts are required by the dates indicated to maintain schedule building:-

Part No.	Description.	No. off	Weeks	25	27	29	31	34	36	38	40	42	44	Operations.
			Sets:	38	50	62	74	86	98	100	112	124	136	
			W/E	19/6	3/7	17/7	31/7	21/8	4/9	18/9	2/10	16/10	30/10	
D.16844	Gear.	1		-	2	12	12	12	12	12	12	12	12	See Gear Chart.
K.10176	Shaft.	1		-	-	-	-	-	9	12	12	12	12	~~BTD BTD STR BSD~~ GHC HT STR ~~BSD BSD BDS~~ SLAB
K.22942	Coupling.	2		-	-	-	-	10	24	24	24	24	24	~~TIRE WHLD~~ CCE CCE PDB SLAB
V.34857	Shaft.	1		-	-	-	-	7	12	12	12	12	12	~~SAE STB BHLF RS~~ SD SLAB STR ~~BSD~~ EGD.
Y.31202	Cover.	1		-	-	-	-	-	7	12	12	12	12	~~GTA GTA~~ MDE SLAB UGC.
Y.31203	Housing.	1		-	-	1	12	12	12	12	12	12	12	~~GTA GTA~~ MDE SLAB IGA EGD.
Y.31204	Housing.	1		-	3	12	12	12	12	12	12	12	12	~~GTA GTA~~ MDE SLAB IGA EGD.
25/44825	Dist. Tube.	6		-	-	18	72	72	72	72	72	72	72	~~STB~~ CCA SLAB.
15/18 Bays														
Y.4739	Stiffnr.Cpte.	2		-	-	14	24	24	24	24	24	24	24	~~RDA~~ SLAB
Y.24306	Angle.	1		-	12	12	12	12	12	12	12	12	12	~~RDA~~ SLAB
Y.24307	Angle.	1		-	12	12	12	12	12	12	12	12	12	~~RDA~~ SLAB
Y.24308	Plate.	1		11	12	12	12	12	12	12	12	12	12	~~MDE MDA~~ MDD RDA SLAB
Y.24309	Plate.	1		11	12	12	12	12	12	12	12	12	12	~~MDE MDA~~ MDD RDA SLAB
Y4/10530	Crossmember.	1		-	-	2	12	12	12	12	12	12	12	~~MDE~~ MDE SLAB.

Fig. 26

ORGANISATION AND CONTROL OF PRODUCTION

PROGRESS SCHEDULE. Date Issued:- 20th March, 1943.

Part No. F.15272	Worm Shafts	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Delivered to Stores	
Batch No.	Qty.	HT	HMB	CTA	SL AB	AM	A D	ELH	HMB	HMB	VMC	SL AB	ELH	EGD	VMC	GHC	CP	HT	STR	ELC	EGD	FGC	SGJ	IGA	EX AM	TINS.	Date	Qty.
1-12B	60	1	2	3	4	5	6	6	7	7	8	8	8	9	9	10	10	10	10	10	10	10	11	11	12	12		
1-12C	65	1	2	3	4	5	6	6	7	7	8	8	8	9	9	10	10	10	10	10	10	10	11	11	12	12		
2-13	60	2	3	4	5	6	6	7	7	8	8	9	9	10	10	10	11	11	11	11	11	11	12	12	13	13		
2-13A	65	2	3	4	5	6	6	7	7	8	8	9	9	10	10	10	11	11	11	11	11	11	12	12	13	13		
3-14	60	3	4	5	6	6	7	7	8	8	9	9	10	10	11	11	11	11	11	11	12	12	13	13	14	14		
3-14A	65	3	4	5	6	6	7	7	8	8	9	9	10	10	11	11	11	11	11	11	12	12	13	13	14	14		
4-15	60	4	5	6	6	7	7	8	8	9	9	10	10	10	10	10	11	12	12	12	13	13	14	14	15	15		
4-15A	60	4	5	6	6	7	7	8	8	9	9	10	10	10	10	10	11	12	12	12	13	13	14	14	15	15		
5-16	60	5	6	6	7	7	8	8	9	9	10	10	10	10	10	11	12	13	13	13	14	14	15	15	16	16		
5-16A	65	5	6	6	7	7	8	8	9	9	10	10	10	10	10	10	12	13	13	13	14	14	15	15	16	16		
WQ. WS.6-17	60	6	7	8	8	9	9	10	10	11	11	11	11	11	11	12	13	14	14	14	15	15	16	16	17	17		
6-17A	65	6	7	8	8	9	9	10	10	11	11	11	11	11	11	12	13	14	14	14	15	15	16	16	17	17		
7-18	60	7	8	9	9	10	10	11	11	12	12	12	12	12	12	13	14	15	15	15	16	16	17	17	18	18		
7-18A	65	7	8	9	9	10	10	11	11	12	12	12	12	12	12	13	14	15	15	15	16	16	17	17	18	18		

Fig 27

Special Urge Lists (L.P.T.B.).

These lists are compiled from urgent requests received from the L.P.T.B. in list form, and are also issued to the Progress Man concerned, with an indication against each item of delivery promises which have been given to the L.P.T.B. These items are discussed with a Representative from L.P.T.B. at a weekly meeting.

Material Shortages (Rough and Bought Out).

Items for which rough material or bought out material is required are extracted and passed to the Order Section for urge purposes, the list afterwards being returned to the Progress Section (Spares) with information in regard to delivery dates or promises against the items affected.

Assembly of Units (A.E.C. Spares).

When complete units are required by A.E.C. Service Stores the Spares Storekeeper issues a Spares Order in duplicate. All available material is issued from stock in the Spares Stores and a shortage sheet compiled for the items which are not available. A copy of this shortage list is passed to the Progress Department (Spares) for progress action.

When all items are available, the material and "S.S." order (in duplicate) are sent to the factory for assembly.

The order is passed to the Rate Fixers for time allowances to be inserted on both copies, and when assembly is commenced one copy of the order is passed to the Central Time Office.

Upon completion, the assembled unit is submitted to the Section Viewer who issues a Pass Forward Slip which is sent with the assembled unit to the Main Stores, the whole of the material is then passed to the Spares Stores together with Delivery Notes, giving full particulars of the job and endorsed with the Spares Order Number.

In cases where Spares Orders are endorsed "Factory to Supply" a Works Order is issued by the Stores Order Section in duplicate.

This order is passed to the Ratefixers for time allowances to be inserted, and then passed to the Progress Section (Spares) who obtain an assembly list showing the parts required for the assembly.

Material which is not available in the main Stores is then urged, and upon completion of all shortages the whole of the material is issued by the Stores from the assembly sheet and passed to the Assembly Section together with the Works Order. A duplicate copy of the Works Order is passed to the Central Time Office.

Assembly of Units (L.P.T.B.).

Upon receipt of an Official Order from the L.P.T.B. calling for assembled units, a Works Order Card is issued by the Order Section and Assembly Sheets applied for to the Specification Section.

Upon receipt of the latter, the Progress Section attach Works Order Card and pass on the Chief Storekeeper for the issue of the necessary material.

Should all the components be available in stock, the whole of the material is passed with the Works Order Card to the Assembly Line concerned and the Material Sheets are passed to Order Section for decarding, the Works Order Card first being passed to the Ratefixing Section for Layout and Job Times.

In cases where there is insufficient material in stock for the assembly of the unit, Chief Storekeeper issues a list of shortages to the Progress Section.

When the Shortages are cleared the Chief Storekeeper is notified and the material issued to the Assembly Line concerned.

Upon completion of the assembled unit it is submitted to the viewer who issues a Pass Forward Slip which is then sent, together with the unit, to the Main Stores.

The Pass Forward Slip is checked with records and decarded, and the Works Order Card passed to Central Time Office.

The Assembled Unit is then finally despatched to the L.P.T.B. together with Delivery Notes, endorsed with the Official Order Number.

A Weekly List is compiled of all units outstanding on L.P.T.B. and A.E.C., and copies distributed to the Production Superintendent and all Assembly Foremen.

Spares Repair Routine.

Upon receipt from customer, all repair jobs are inspected by Spares Viewer, after which an "S.S." Order is passed by Spares Storekeeper, giving full particulars of the part concerned and repairs to be undertaken.

The job, together with Delivery Note and Spares Order, is passed to Main Factory via Progress Section, who, after recording particulars attach Work Label to the job and pass to Assembly Section concerned.

The Spares Order, meanwhile, is passed to the Ratefixing Section for Layout and job times, and is then issued via Progress Section and Central Time Office to the Assembly Line indicated, and the Delivery Notes filed for reference.

In cases where work is to be done in the Machine Line, a Works Order Card is passed to the Central Time Office as an authority to issue the necessary Work Ticket, where it is retained until the job has been cleared by the Pass Forward Slip.

Should it be necessary during the course of repairs for any part or parts to be replaced, a requisition, endorsed with the Spares Order Number, is issued by the Assembly Foreman to Progress Man who, after verifying authenticity, obtains the material from Spares Stock.

Upon completion, the repaired part or unit is submitted to the Viewer, who issues Pass Forward Slip endorsed with a Spares Order Number, Part Number, Quantity and brief particulars of the work that has been done.

The job is then passed to Main Stores and finally passed to Spares Viewer, together with Delivery Notes and any scrap parts.

A list of all repair jobs is compiled weekly, copies distributed to Production Superintendent and all Foremen concerned.

L.P.T.B. Repair Routine.

Upon receipt in Goods Inwards from L.P.T.B., a Works Order Card is issued chargeable to L.P.T.B. Official Order Number, and passed to Ratefixers for job times and layouts.

The job, together with the Works Order Card, is passed to the Section concerned in the necessary repairs.

Upon completion, Pass Forward Slip is issued by the Sectional Viewer and passed, together with the job, to the Main Stores, particulars being recorded on Stores Records and the job despatched to L.P.T.B. with Deliver / Notes endorsed with Official Order Number.

All work received from the L.P.T.B. for re-conditioning, is covered by the issue of a Factory Order chargeable to the L.P.T.B. Official Order Number, the job times being fixed by Ratefix rs and the order passed to Cost Office for signature.

Daily Progress Meetings.

Daily meetings of all Progress Men are held, under the supervision of the Chief Progress Man, at which the position of all items controlling production is discussed. Certain of these items are extracted and a list compiled and circulated to all Production Supervision for special attention and action.

Material Control Meetings.

A weekly meeting of Outside Material Control Representatives and Material Control Clerks is held, and is also attended by the Chief Progress Man. (See also page 404).

The position of all items which are in short supply are discussed and action taken where necessary to ensure that production plans are maintained.

Production Supervision Meetings.

A meeting of all Production Executives is held weekly under the chairmanship of the Production Superindendent (see also page 52). This meeting is attended by the Chief Progress Man, by whom a statement is presented of all items regarding production, in order that the Production Superindendent may take appropriate action with those concerned.

Works Manager's Meeting.

A weekly report is submitted to the Works Manager by the Chief Progress Man of items affecting production which require special action. These matters are discussed at a weekly meeting of Production Executives, presided over by the Works Manager.

INTERNAL (WORKS) TRANSPORT

Functions.

Transportation and Handling by Mechanical and Manual means of all materials in the Production Departments.

The problem of Transportation of Materials is of sufficient importance as to amply justify considerable time and thought on its development, in order to effect synchronised movement of materials in relation to production flow.

Transport plans must be so arranged that materials are transported from point to point in a direct line, if possible without retrogression and to preclude the necessity of handling materials by operators.

The amount of time usually involved in travel during process of manufacture is considerable and is often an important factor in costs, therefore retrograde movement of work in progress must be reduced to a minimum.

The extensive use of Air Hoists and the fact that the Production Departments are arranged on the basis of "flow" or "progressive" production does much to eliminate the necessity for manual handling of materials.

All transport facilities throughout the Production Departments, both manual and mechanical, are operated and controlled by the Production Control Department.

Mechanical Transport.

For the transport of Goods to and from the various Production Departments, the following Petrol Engine Platform Trucks are employed :

14 Lister Trucks (3½ h.p. Jap Engine), with trailer, hauling capacity of two tons.

One Lister Truck (3½ h.p. Jap Engine), with a hauling capacity of one ton.

One Brett Truck (4 h.p. Cov. Twin Engine), one ton load capacity.

These trucks are operated and serviced by the Production Control Department under the control of a Transport Foreman, and are each engaged on transport duties of a specific nature prescribed by the Transport Foreman, Trucks are diverted when

necessary, for transportation of Goods urgently required, upon application direct to the Transport Foreman.

For stacking material of a heavy and bulky character, a Morris Stacking Machine is provided. This machine is electrically operated. being equipped with a 1 h.p. Electric Motor, and has a lifting capacity of approximately 10 cwt.

A Hyster Mobile Crane, equipped with a 16 h.p. 4 Cylinder Petrol Engine, is provided for the purpose of lifting and positioning material of a heavy or bulky nature.

Railway trucks are hauled from the Great Western Railway sidings to the A.E.C. private line by an Oil Engined Locomotive of A.E.C. design and manufacture. Trucks shunted on to the Great Western Railway siding overnight, are coupled to the loco and hauled each morning to the Goods Inwards, Steel Stores or other location within the factory. After unloading, material for despatch by rail is loaded up and the trucks returned to the Great Western Railway siding.

Manual Transport.

Transport of materials by manual effort is principally confined to the Machine Lines, and for this purpose Transport Labourers are allocated to the various sections under the supervision of the Transport Foreman.

These duties mainly consist of transporting work in progress within the sections to which they are attached, assisting operators where necessary in handling the heavy components and removing finished work from their respective sections to the Section View Room.

The usual method of transport in this case being the ordinary type of sack barrow or scooter box.

When material of a delicate or highly finished character is handled, great care is taken to avoid damage during transit, and for this purpose means of transport are provided in the form of specially designed mobile racks, trays and boxes. Cardboard ferrules are also provided for protection of threads and ground diameters.

For the reception of component parts in the machine lines awaiting machining, steel barrels or bins are provided, preventing material being scattered around the floor, and also ensuring each individual batch of work is kept intact.

Experiments are continually being conducted with a view to reducing to a minimum the amount of manual effort required for transportation of materials.

It is extremely difficult, if not altogether impossible, to entirely eliminate manual effort, but the Internal Transport will shortly be equipped with the Tug Lift System which should go a long way towards solving the problem.

EXTERNAL (ROAD) TRANSPORT

To overcome difficulties experienced in regard to transportation of urgent materials under existing conditions, a fleet of Transport Vehicles is operated and controlled by the Production Control Department.

These vehicles are used for the conveyance of all urgent materials and Tank units to and from the factory, and operate in the London area, Home Counties, Midlands, Northern and Southern Scottish areas.

The fleet is comprised of the following transport vehicles and is under the direction of a Transport Foreman in whom all requests for transport facilities are centralised.

One 6 *ton Capacity Flat Low Loader.* Used for carrying Spares to Chilwell, etc. and small collections in Birmingham area.

Five 8 *wheel,* 16 *ton vehicles.* Used for delivery of material and engines to Birmingham, Newcastle, Manchester, Glasgow and all districts. Collections from Liverpool Docks and all heavy loads. Each fitted for drawing trailers. Gross load with trailer 22 tons.

Two Eagle Trailers for use with above vehicles.

One 2½ *ton Experimental Vehicle.* Carrying capacity 5 ton. 30 m.p.h. Vehicle used for emergency jobs, loads for engines, etc.

One Mercury Lorry. Carrying capacity 6 to 7 ton. Used for collection and delivery of material to and from Standard Road Works.

Three Marshall 6 *wheel vehicles.* Production Control Department London work. Allocated to Mr. Skinner's Department but used by the Production Control Department for London area work.

One Monarch 4 *wheel,* 6 *ton capacity.* Allocated to Spares Department. Frequently used for delivering Spares to Chilwell, etc., returning with load for Production Control Department.

One 2 *ton Austin Lorry.* Used for urgent collection or delivery work.

Two Commer 7 *cwt. Vans.* Used for London area only.

All requests for transport facilities are passed to Transport Foreman on REQUEST FOR TRANSPORT FACILITIES, Form No. D 5154 (Fig. 29), stating location or designation from which goods are to be collected or delivered, details of goods to be transported, quantity and approximate weight of load and particulars in regard to the time and date upon which delivery or collection is required.

The Transport Foreman is responsible for ensuring that as far as is practicable all transport vehicles carry economic loads on both outward and homeward journeys, and to assist him in this respect the Sales Inspection, Service and Spares Departments have instructions to consult him before arranging transport by other sources.

THE ASSOCIATED EQUIPMENT CO. LTD.
Southall, Middlesex.

Telegrams: Vangastow 'Phone Southall.
Telephone: Southall 2424 - Ext. 11.

Driver's Name. _____ Lorry Number. _____ Date. _____

TRANSPORT INSTRUCTIONS.

OUTWARD JOURNEY.					RETURN JOURNEY.				
Date & Approx. Time		Collect from.	Description of Goods.	Deliver to	Date & Approx. Time		Collect from.	Description of Goods.	Deliver to
	am.					am.			
	pm.					pm.			
	am.					am.			
	pm.					pm.			
	am.					am.			
	pm.					pm.			

SPECIAL NOTE:- If, for any reason, it is found necessary to deviate from these instructions, contact must immediately be made to the undersigned, at Southall, by wire or 'phone, or, after normal working hours to Mr.Skinner. Tel.No.Hounslow 1356

DRIVER'S COMMENTS:-

Copies to:- Mr. Skinner, Driver & P.C.D.
M.1099.

Signed. _____ P.C.D.

Fig. 28

REQUEST FOR EXTERNAL TRANSPORT FACILITIES.

TO: Mr. Gasking. Date 1/4.12.41.

Transport facilities are required to ~~deliver~~ collect the following material.

from Messrs. L.N.E.R.

of STRATFORD.

* Strike out where not applicable.

Part No.	Description of Goods.	Qty	Approx. Weight: T.	C.	Q.	L.	Particulars (Time & Date) collection or delivery is required.
A.74928	Housing.	61					O/No. 52922.
	Gauge	1					From loan on
	Fixture	1					above order.
	Mandrel	1					

Signed p.p. A.C.Hann.
Dept. or Section. Planning.

NOTE:- All Goods required for despatch must be passed to Goods Inwards prior to issue of this note, unless there are reasons to the contrary, in which case the location of Goods must be stated on this form.

D.5154.

Fig. 29

Transport drivers are given full detailed instructions in regard to destination and load to be collected or delivered on DRIVER'S INSTRUCTION, Form No. M.1099 (see Fig. 28).

Contact is maintained when necessary between the driver and headquarters at various points en route in order that revised instructions may be transmitted without delay.

STORES AUDIT SECTION

Functions.

Perpetual Stores Check, Disposal of Surplus Material, Obsolete Material, etc.

The Stores Audit Section, although attached to the Production Control Department, is under the control of the Chief Accountant.

The main functions of this section are indicated below :

1. A systematic and perpetual check of all Stores Stocks.
2. Check on Surplus Material created by Alterations to Design.
3. Check on Surplus Material created by Sales Alterations.
4. Comparative check on Material ordered for Chassis Production against existing Stocks and Commitments.
5. Check and Disposal of Surplus Material created by excess deliveries from Outside Suppliers.
6. Record and Disposal of Obsolete Material.

Perpetual Stores Check.

A physical count is made of Stores or Bin Stocks, the resultant figures being compared with the Master Record Card in the Order Section. Any errors are at once adjusted and a report submitted to the Chief Accountant on INTERNAL AUDIT REPORT, Form D.1104.

A copy of this report is passed to the Superintendent of the Production Control, and a third copy retained in the book for reference purposes, the Master Record Card being signed by the Stores Auditor as an indication of the check.

Comparative Check—Stocks and Commitments.

A periodical check is taken of the Master Record Cards to ensure that all surplus material has been taken into consideration when ordering material for new sanctions or spares requirements.

We are indebted to the Associated Equipment Company, Ltd., for permission to reproduce the foregoing article, whose system of production control it explains.

LIST OF DOCUMENTS REFERRED TO IN THIS BOOKLET.

Description.	Form No.	Source of Origin.
Production Schedule.	PR.1	Specification.
Component Parts List (Schedule 'A')	ST.5604	" "
Material Analysis Cards.	MA.1	" "
Alteration Advice Notes.	ST.05391	Drawing Office.
Material Analysis Statement.	MA.2	Specification.
Assembly Lists.	0546	" "
Shops Alteration to Binder Request.	AB.1	" "
'X' & 'XU' Assembly Lists.	ST.05182	" "
Reference Sheets.	M.1052	" "
Sales Altn. Instructions.	5605	Sales.
Chassis Priority Lists.	CP.1	Specification.
Weekly Production Report.	WPR.1	" "
Index Card (New Dies and Stampings).	M.1087	" "
Request for Despatch Note (Patterns).	M.0602	Purchasing Agent.
Pattern Order.	M.4012	Specification.
Works Order.	4022	" "
Master Record Card (Rough & Work in Progress).	ST.40551	Order & Urge.
Master Record Card (Bought Out Items).	ST.40553	" "
Production Release Note.	M.1049	" "
Purchase Requisition.	ST.8897	" "
Purchase Order.	0612	Purchasing Agent.
Preliminary Requisition (Bar and Tube).	M.1034	Order & Urge.

Description.	Form No.	Source of Origin.
Commitment Record Card (Bar and Tube).	M.1073	Order & Urge.
Stock Card (Bar and Tube)	M.1073a	" "
Goods Received Note (Rough) 'A'	02893/5/40.	Goods Inwards.
Material Requisition (Notice of Issue).	M.02601	Order & Urge.
Pass Forward Slip.	30191	Inspection Dept.
Daily View Report.	3701	Inspection Dept.
Goods Received Note (Bought Out Material).	02993/5/40.	Goods Inwards.
"Paid Off Today" Sheets.	M.1028	Stores(Finished)
Delivery (R.M.) Notes.	M.8842	Internal Audit.
Delivery (A) Notes.	M.8842a	" "
Internal Audit Report.	D.1104	Stores Audit.
Docket (Outside Material Control).	M.1097	Order & Urge.
Preliminary Process Layout.	PPL.1	Process & Rate-setting Section.
Operation Detail Card.	M.4023	" "
Master Process Layout.	M.40291	" "
Operation & Tool Layout.	05321	" "
Alteration to Layout.	ST.5821	" "
Advice of Altn. to Tool Layout.	M.0535	Jig & Tool Drawing Office.
Target Time Investigation Slip.	M.5818	P. & R.S.
Plant Record Card.	M.5808	"
Planning Study.	M.1053	Planning.
Calendar.	CA.1	"
Tool Equipment Schedule.	TE.1	"
Urgent Drawing & Layout Request.	DLR.1	"

Description.	Form No.	Source of Origin.
Planning Schedule.	P.1	Planning.
Traders Schedule (Rough and Bought Out).	M.1043 & M.1043a.	"
Factory Schedule.	ST.4068	"
Job Card.	M.1038	"
Job Label.	4065	"
Cope-Chatterton Index Card (Plant).	P.2	"
Machine Tool Movement Notice.	M.1048	Plant Engineer.
Factory Schedule Machine Load.	M.1080	Planning.
Machine Load Summary.	ML.2	"
Cope-Chatterton Index Card (Part & Opns).	P.3	"
Department Machine Load Summary.	ML.1	Planning.
Outside Machining Instruction.	OM.2	"
Jig & Tool Instruction (Outside Machining).	OM.3	"
Outside Machining Record Card.	D.1106	"
Jig and Tool Record Card (Outside Machining).	OM.1	Tool Room.
Priority No.1 List.	PL.1	Progress.
Factory Shortage List (Progress).	S.1	"
Progress Schedule.	M.1060	"
Job Change Ticket.	ST.0260	Central Time Office.
Transport Label.	7749	Progress/Inspn.
Operations Overdue Report.	OO.1	"
Chassis Building Instruction.	CB.1.1.	"

Description.	Form No.	Source of Origin.
Stores Shortage List.	SS.1	Finished Stores.
Reject Note (Ass).		Production Depts.
Return to Stores Note.	M.1039	Progress.
Goods Received Note (Bought Out Material).	02993	Goods Inwards.
Material Requisition (Blue)	ST.8021	Production.
Goods Received Note.	ST.3012	Steel Stores.
N.P.L. Label.	ST.40255	" "
Stock Card (Steel Stores)	ST.0439	" "
Reject Letter.	M.3702a	Inspection.
Goods Received Note (Consumable Stock).	02992	Oil Stores.
Delivery Schedule (Tyres)	T.1	Tyre Stores.
Allocation Order Form.	75879-1	Tyre Stores.
C.I.M. Inspection Notes.	MCS.99	" "
Goods Received Note.	ST.3012	" "
Stock Card.	ST.0439	" "
Monthly Statement (Disc Wheels).	T.2	" "
Reject Note (Assembly).	M.8918	" "
Consignment Notes (O)		Goods Inwards.
Advice of Goods without Deb. Notes.	8928a	Goods Inwards.
Variations - Advice of Goods.	8928	" "
Temporary Advice Note.	3016	" "
Request for Transport Facilities.	D.5154	External Transport.
Drivers Inst. Form.	M.1099	"

Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

NOTE.—*The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.*

EMPLOYEES, (WORKMEN, APPRENTICES).

Skilled Men and Female Labour for Gauge and Toolmaking. (*Machine Shop, November, 1943, Vol. 4, No. 11, p. 44*).

Memorandum of the Council of the Gauge and Tool Makers' Association. Present position. Relationship of the industry to war effort and man power problem. Classification of gauge and tool shops in relation to the labour position. Retention of key skilled men. Recruitment of "Green" and female labour. Misuse of skilled tool and gauge labour. The grave effect upon the nation's manufacturing programme of any hold-up in the supply of essential gauges and tools.

COMBUSTION, FURNACE.

Salt Bath Heat Treatment for Emergency Steels. (*Machine Shop, November, 1943, Vol. 4, No. 11, p. 80, 6 figs.*).

Representation of the heat treating cycle. Layout of an automatic heat-treating installation to carry out the heat-treating cycle. Depth of case as a function of carburising time at 1,700°F. Table showing analyses and properties of chromium-manganese carburising and hardenable steels. Diagrammatic representation of carburising cycle. Representation of hardening cycle of emergency high speed steels of the low tungsten composition.

GEARS, GEARING.

Gear Grinding. (*Automobile Engineer, November, 1943, Vol. XXXIII, No. 443, p. 477, 7 figs.*).

Form wheel grinding for the teeth of gears and for spline shafts is being used to an increasing degree to provide the accuracy and quality of surface finish that are required for many present-day applications. The Gear Grinding Co., Ltd., machines embodying the Orcutt principle of form wheel grinding, are described in detail. The latest development in form wheel grinding for gear teeth is the helical gear grinder. Production limits that can be guaranteed are given for each machine. A very high degree of precision in indexing is essential to any system of gear tooth grinding, and a special indexing mechanism is incorporated in the Orcutt machine. The indexing plate, with the correct number of locating teeth, is made from close-grained cast-iron. Each locating tooth is truly radial and is ground very accurately on a special dividing engine. The spacing of the locating faces is accurate within plus or minus 0.0001 in. accumulated error on 16 in. diameter. For each division the radial side of a tooth contacts a pawl, and it is upon this that the accuracy of the indexing depends. The design of the patented mechanism

is such that the actual locating faces are practically free from wear. Despite the accuracy that is an essential part of the system, change-over from one indexing plate to another is easily effected.

The Production Heat Treatment of Gears. (*Mechanical World, 19th November, 1943, Vol. 114, No. 2968, p. 583, 2 figs.*).

The classification and ultimate selection of materials for gears. The majority of gears of a diameter less than 12 in. are manufactured from carbon or alloy case-hardening steels. Carbon content of carburising steels. Theoretical stress relationship between core and case depth. The grain size of casehardening steels. Alloy casehardening steels. Effect of alloy additions. Full hardening steels. Recommended gear materials. Forged and rolled carbon steels for gears. Forged and rolled alloy steels for gears. Steel castings for gears.

Backlash in Gears—I and II. (*The Machinist, Reference Book Sheet, 20th November, 1943, Vol. 87, No. 31, p. 105, 3 figs.*).

Backlash in gears is play in the teeth. For purposes of measurement and calculations, backlash is defined as the amount by which a tooth space exceeds the thickness of an engaging tooth measured on the pitch circles. Backlash between tooth profiles of gears. Backlash in pitch plane. Providing backlash. Control of backlash. Measurement. Recommended backlash.

Tolerances for Bevel and Hypoid Gears—I and II. (*The Machinist, Reference Book Sheet, 13th November, 1943, Vol. 87, No. 30, p. 125*).

Scope. Diameter range. Pitch range. Classes and speeds. Types of errors : 1. runout ; 2. pitch error ; 3. accumulated error ; 4. required tooth contact. Inspection tolerances for straight, spiral, and zero bevel, and hypoid gears in ten-thou. of an inch.

HEATING, VENTILATION.

Electrostatic Heating, by James F. Driver. (*Machinery-Lloyd, 13th November, 1943, Vol. XV, No. 23, p. 37, 5 figs.*).

Diagram showing the "Thermex" system of electrostatic heating. Arrangement of rectifiers for 60 kW. "Thermex" equipment. High frequency generating equipment for 60 kW. set. Transformer and rectifier equipment for 600 kW. "Thermex" electrostatic heater.

KINEMATICS.

Cardioid Cam Construction, by W. Cooper. (*Machinery, 11th November, 1943, Vol. 63, No. 1622, p. 544, 5 figs.*).

The motion obtainable from this heart-shaped curve is such that, even in the pure fundamental form, it approximates closely to constant lift for equal angular movements, with a slight grading off at half-turn positions. The fundamental cardioid curve. Graph showing the motion of a cardioid cam. A constant lift cam. A cardioid cam with a rocking lever follower.

MACHINING, MACHINE TOOLS.

The ABC of Internal Grinding, by E. T. Larson. (*Machine Tool Review, September—October, 1943, Vol. 31, No. 187, p. 118, 9 figs.*).

The basic requirements of an efficient grinding machine operator may be summed up under three main headings : (a) know your grinding machine

and how to set it up for each job, (b) select the proper grinding wheel for each job, (c) be able to recognise common grinding troubles and to correct them.

Take a Healthy Chip, by F. J. Wintersdorff. (*The Machinist, 20th November, 1943, Vol. 87, No. 31, p. 87, 1 fig.*).

Replace "feed per tooth" by "basic table advance per tooth." The relationship between the basic table advance per tooth and the actual chip produced at various depths of cut. Chart for determining feed per tooth and maximum chip thickness. Comparative production results from setting milling speeds and feeds by three methods: A. Rule of thumb; B. Basic table advance per tooth; C. Maximum chip thickness.

CHIPLESS MACHINING.

Mass Production of Press-Formed Parts, by R. Dewert. [*Sheet Met. Ind., September, 1943, Vol. 18, No. 197, p. 1583, 1593, 1602* (*Based on an article in Revue Universelle des Mines, 8th Series, Vol. 18, No. 5, p. 154*)].

A general account of tools, machines, operations, heat treatments, properties required of materials, etc., illustrated by examples.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Shaping Metal Airframe Parts. (*Aircraft Production, December, 1943, Vol. V, No. 62, p. 566, 16 figs.*).

The well-equipped sheet metal forming department installed at a de Havilland factory in this country. Except for the blanks which are routed to profile in another shop, the department is self-contained for shaping components by the drop-stamping, rubber-pressing and stretch-pressing processes, and includes a foundry for the production of the necessary tools and refrigeration plant for storing blanks after normalising.

MANUFACTURING METHODS.

The Repair of Worn or Over-Machined Parts by Electrodeposition, by A. W. Hothersall. (*Engineering, 26th November, 1943, Vol. 26, No. 43, p. 438, 10 figs.*).

With few exceptions, electrodeposition is satisfactory as a general method of repairing worn or over-machined parts of machines, vehicles, engines, guns, etc. The mechanical properties and the adhesion of the deposit must be suitable and reliably controlled if the process is to be successful. Hardness of electrodeposited metals. The cause of the high hardness is variously attributed to (1) hydrogen, (2) small grain size, (3) included non-metallic matter. Tensile properties. Adhesion of electrodeposited metals. Suitability of different metals for building-up from the point of view of adhesion. Stress in electrodeposited metals. Electrodeposited coatings are even, in thickness, only under ideal conditions, seldom or never realised in practice. Tensile properties: average results. Effect of electrodeposited coatings on mechanical properties of steel. General notes. Two metals only are in common use for building up over-machined parts, namely, nickel and chromium. There is no theoretical limit to the thickness which can be applied, and there is no important change of properties or adhesion with thickness. The metal must either be applied in sufficient thickness that it can withstand any indenting force likely to be met, irrespective of the hardness of the base, or the base must be chosen of sufficient hardness, so that an economically thin coating can be applied.

MATERIALS, MATERIAL TESTING.

Light Alloys in Machine Tools. (*Light Metals, October, 1943, Vol. 6, No. 69, p. 486*).

An account of the ways in which the lightness and other properties of Al alloys are utilised in abrasive wheels, hammers, hand tools, gauges, etc.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Chevrolet Casts Magnesium. (*Foundry, U.S.A., August, 1943, Vol. 71, No. 8, p. 90*).

An illustrated account of the changeover of part of this foundry from grey iron to Mg-casting.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Hardenability, by J. G. Richie. (*The Australasian Engineer, 7th July, 1943, and 7th August, 1943, Vol. 43, Nos. 326, and 327, p. 14, 25 figs.*).

Hardenability of plain carbon and low alloys steels. Relation between maximum hardness, critical hardness, and carbon content. Schematic representation of relation between cooling rate and temperature of initial transformation in a eutectoid steel. Hardness distribution curves for two steels of different hardenability. Fundamental considerations. Hardenability tests. SAE 3140 quenched in oil and water. Relation between ideal critical size, actual critical size, and severity of quench. Diagrammatic sketch of Jominy end quench hardenability test. Effect of various factors on hardenability. The austenite grain size at the actual quenching temperature is of importance. Recent work published by Grossmann is most illuminating ; the ideal critical size. Correlation between hardenability in terms of ideal critical size and distance from water cooled end. Jominy curves for nickel chrome steel quenched from 815°C. and 925°C. for various soaking times. Base hardenability of pure iron-carbon alloys as a function of carbon content and grain size. Variation of hardenability with carbon and manganese in medium manganese steel SAE 1340. Applications of hardenability testing.

MEASURING METHODS.

Fine Accuracy in Turret Lathe Work. (*Machine Tool Review, September—October, 1943, Vol. 31, No. 187, p. 99, 3 figs.*).

The use of dial gauges so that the exact dimension is visually indicated. Accuracy of duplication can then be maintained to .0005 in. It is preferable to use dial gauges graduated to .0001 in. for the finest work as these greatly facilitate reading. Examples : Dial gauge fitted to (a) the cross slide when turning cotter grooves in aero-engine valves, (b) the saddle when turning collars on a cast iron pump body ; (c) arrangement for turning a number of diameters, using a dial gauge and suitable length gauges.

X-Rays in the Light Alloy Foundry, by F. R. Mansfield. (*Light Metals, October, 1943, Vol. 6, No. 69, p. 469*).

Describes the way in which radiography is used to maintain a high standard of Al-alloy casting.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Testing Hardness and Uniformity of Abrasive Wheels, by P. Grodzinski, (*Industrial Diamond Review, November, 1943, Vol. 3, No. 36, p. 61, 10 figs.*).

Comparator for the routine testing of the fine grained aluminium oxide wheels used for the fine grinding of razor blades. A pointed diamond is rotated under a given load and a distinct speed for a distinct number of revolutions, and simultaneously the distance the diamond point has dropped is observed, corresponding to the depth of impression made into the wheel. Side elevation of a new Gillette abrasive wheel testing machine. Different diamond and steel points used in routine and experiments. Data obtained from motion picture record of a penetration of point. The diamond drills cut from 1,500 to 3,000 craters in aluminium oxide wheels, vitreous or resin bounded, without serious wear. Six places on each cylindrical abrasive wheel are tested.

PLASTIC MATERIALS, POWDER METALLURGY.

Machining and Finishing Tenite. (*The Tool Engineer, (U.S.A.), October, 1943, Vol. XII, No. 10, p. 85, 4 figs.*).

Production facts on a particular type of plastic indicate some of the tooling problems which are becoming increasingly important in mass-manufacturing. Sawing with a recommended peripheral speed of 6000 feet per minute. Warming the sheet is essential in obtaining a smooth edge in shearing, blanking, punching. Tenite is satisfactorily worked with machine drills used for wood. Sanding is done on the coarse belt and finish sanding on a fine belt, running at 2000 feet per minute. Ashing produces a satin-like surface. The operation is done on a wheel built up of muslin discs. Lapping. Polishing. Buffing. Tumble polishing. Dip-finishing and colouring.

Thermoelastic Forming of Airplane Parts, by W. I. Beach. (*Mechanical Engineering (U.S.A.), October, 1943, Vol. 65, No. 10, p. 719, 10 figs.*).

Development of thermoelastic forming process. Forming characteristics of thermosetting sheets. Analogy between the aluminium alloys and thermosetting laminates; aluminium is crystalline in structure, thermosetting plastic is amorphous. Whereas aluminium deforms by slippage of crystals along planes of weakness, laminates deform by an incremental sliding and stretching of the adjacent layers of fabrics. Typical airplane parts formed by thermoelastic process. Typical dome-light mounting bracket. Plastic sheet formed into stiffened panel. Wing-gun ammunition-feed chute. Relative forming capabilities of aluminium and laminated plastics. Sphere of applications for plastics. Plastic parts must be better than their metal counter-parts.

Metal Working in Powder Metallurgy, Parts I—III, by C. G. Goetzel. (*Wire and Wire Prod., June, July, August, 1943, Vol. 18, Nos. 6, 7, 8, p. 329, 355, 394, 427, 457*).

Part I discusses the working properties of powder-metallurgy products. Part II describes industrial methods used in the manufacture of refractory products, and Part III describes experiments on sintered Fe and Cu.

(*Communicated by the British Non-Ferrous Metals Research Association*).

PSYCHOLOGICAL INVESTIGATION.

How to Select New Supervisors. (*Personnel, (U.S.A.), September, 1943, Vol. 20, No. 2, p. 66*).

With rapid expansion of supervisory staffs has come the urgent need for a more systematic method of selecting first-line supervisors. An organised

method of inventorying the abilities of rank-and-file workers to determine who will profit most from foremanship training. Based on industrial experience, the procedure includes participation of present supervisors in the nomination of candidates ; use of an objective measure of practical ability, and acceptance or rejection of candidates by a special selection committee.

SHOP ADMINISTRATION AND MANAGEMENT.

Planning, by D. Anderson. (*Journal of the Institution of Civil Engineers, November, 1943, Vol. 21, No. 1, p. 1*).

Planning in other countries. Lack of planning in Great Britain : how the nation is governed. Advantages and disadvantages of planning. A programme of planning. How is this programme of planning to be brought about. The spiritual side of planning.

Foreman as Manager. (*Production and Engineering Bulletin, November, 1943, Vol. 2, No. 12, p. 532, 3 figs.*).

The foreman's department is a miniature of the whole business. The activities and responsibilities of a foreman are very similar to those of the different grades of management above the foreman. Keeping down the overheads.

SMALL TOOLS.

The Relief of Formed Cutters, by J. G. Smith. (*Machinery, 25th November, 1943, Vol. 63, No. 1624, p. 599, 4 figs.*).

A practical study of the technique of applying relief to the teeth of rotary-type cutting tools. Methods of determining the form of the relieving curve in specific cases are simply described, also processes of relieving various forms of cutters. Various clearances and their relation. Calculating the angle for any profile. Relieving tool for a form-milling cutter with radial teeth. Relieving tool for a form-milling cutter with hooked teeth. Relieving tool for hob with spiral flutes and radial teeth.

More Production from your End Mills, by Justin Wright. (*The Tool Engineer (U.S.A.), October, 1943, Vol. XII, No. 10, p. 70, 8 figs.*).

Complete charts and supporting formulas to operate end mills as economical production tools. Plot of deflection related to the chip per tooth from tests on end mills. The relationship of the deflection rate (1) to depth of cut plotted on bi-log paper, (2) to the width of cut, (3) to diameter of cutter.

Cast Cutters Boost Milling Capacity, by W. C. Whittum. (*The Machinist, 6th November, 1943, Vol. 87, No. 29, p. 92, 5 figs.*).

The combination of Meehanite bodies and brazed tips forms a ready supply of tools for an expanded milling machine department, saves critical high-speed steel, expedites solution of special problems. Procedure for brazing carbide tips to tool shanks.

Surface Finish with Diamond Tools. (*Machinery, 18th November, 1943, Vol. 63, No. 1623, p. 573, 5 figs.*).

General investigation into the factors governing the turned finishes obtained with diamond tools. Objects of the tests were to obtain fundamental information on the surface finish obtained with diamond tools. Three main criteria : a low average meter reading, a good graph and a good visual appearance. The results described were obtained from machines normally

running on production. These machines were free from vibration. The spindles were precision lapped, running in properly fitted plain bearings and had accurate endwise location. The machines were correctly mounted and had independently mounted motors, the drive being by endless belts with a minimum of tension and without slip. A minimum of gearing was used. Four production runs were then undertaken, 100 pistons being machined on each run. The finish on first piston was *have* = 1.7, the total height (straddle) 19 mu. in. on the hundredth piston 1.9 and 19 mu. in. respectively. Diamond tools used for the tests. Conclusions : An average meter reading of 3 micro-inches maximum and a total height of 25 micro inches maximum were selected as the limits. Tools used in the production runs have now been in continual operation for three months without exceeding these limits.

SURFACE, SURFACE TREATMENT.

Securing Fine Surface Quality, by H. J. Wills. (*Machinery, 4th November, 1943, Vol. 63, No. 1621, p. 513*).

Some points in grinding machine operation that should be watched if fine surface quality is to be obtained. Parts may be given a finish of 2 micro-inches average. Holding the dimensional accuracy to within 0.0005 to 0.00005 inch tolerance for diameter, and to 0.00005 inch tolerance or less for roundness and straightness. Cause of failures : (1) inadequate power, (2) wheel-spindle in poor condition. The modern way to recondition a grinding machine spindle. (3) vibration, (4) belts of uneven thickness or pliability, (5) loose or out-of-balance idler pulleys, (6) backlash in drive gears, (7) loose pulley on the spindle, (8) worn traverse drive parts, (9) misalignment of headstock and tailstock or of wheel-head and work, (10) miscellaneous causes.

Processing Layouts for Metal Cleaning, by C. W. Smith, U.S.A. (*The Machinist, 6th November, 1943, Vol. 87, No. 29, p. 101, 4 figs.*),

Metal cleaning should properly be considered in relation to the prior and succeeding operations in a metal-finishing sequence, or in other production processes where cleaning is a factor. From the facts developed by such an analysis it is possible to provide a cleaning method and a cleaning material that will satisfy the particular conditions encountered. Cleaning problems fall into three general classifications : (1) Cleaning after one operation as a necessary preliminary to a subsequent operation. (2) Cleaning before the application of a protective or decorative coating. (3) Cleaning as the final operation prior to assembly or inspection.

TECHNICAL EDUCATION.

Training Women Workers. (*Personnel (U.S.A.), September, 1943 Vol. 20, No. 2, p. 100*).

Planned induction training and progressive training in actual job requirements, supplemented where necessary by related instruction, make up the pattern followed by three companies which have successfully trained women in operations habitually performed by men. Training policy. Trainee selection. Orientation training. Special problems. Foreman reluctance to accept women in production departments. Women as supervisors and foremen. Shifts and working hours. Absenteeism and turnover. Plant facilities and adjustments. Safety and clothing.

TECHNICAL INFORMATION.

Stabilised Quality Control, by H. Howell. (*Aircraft Production, December, 1943, Vol. 5, No. 62, p. 579, 3 figs.*).

Abuse of system. Practical example. Spread of control lines. "Rissik" correction values. Statistical results. Advantages of scheme. Interpreting the process record. Mean dimension. Patrol times. Checks. Dimensional defectives. Dot diagram construction. The routine.

Production Control, by W. V. McClung. (*Mechanical Engineering (U.S.A.), October, 1943, Vol. 65, No. 10, p. 719, 16 figs.*).

Control as practiced at Vultee Field Division of the Consolidated Vultee Aircraft Corporation. The paramount function of the production-control system to be considered is to ensure that schedules are met. Formulating the schedule. Functional chart showing relationship of production to other departments. Master schedule board. Order release. Cost centre despatch. Plant layout. Interdepartmental transportation. Assemblies departmentalized with cost-centre control. Major assemblies of the airplane.

WELDING, BRAZING, SOLDERING.

Choice and Preparation of Welding Edges for Metal Arc Welding, by E. Fuchs. (*Welding, November, 1943, Vol. XI, No. 12, p. 494, 16 figs.*).

Before considering the method to use in preparing plates and other material for welding, it is absolutely essential to decide exactly what type of weld is required and what shape of groove or welding edge will result in the deposit of weld metal. The vee butt joint (without backing strip). The vee butt joint (with backing strip). The double-vee butt joint. The U-butt joint. The single J joint. The single bevel joint.

Rapid and Accurate Inspection of Spot Welds, by L. L. Anderson. (*Met. Progress, September, 1943, Vol. 44, No. 3, p. 433, 462*).

An account of a hand-operated tensile tester of 7500 lb. maximum capacity for testing spot welds in single shear. The machine can also be used for test-brazed, riveted and other joints.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Assembling Metal Components, by J. L. Miller. (*Sheet Metal Industries, November, 1943, Vol. 18, No. 199, p. 1971, 17 figs.*).

Spot welding v. projection welding. Copper-brazed crank. Strength of joining process. Consistency and reliability of the processes chosen. Riveting v. spot welding. The spot welder or butt welder as a riveting machine. Heading-in butt welder. Riveting case-hardened pins in spot welder. Tungsten contact rivet. Stress concentration on spot weld. Fatigue strength. For severe vibration two spot welds for positioning and then copper brazed. Brazed bolt with flange. Cup and bolt to be gas-tight. Choice of copper brazing or projection welding with annular projection. Soldering, brazing or silver soldering by electrical heating. Copper brazing limitations. Limitations of spot and projection welding. Projection welding limitations. Entirely impartial choice is necessary.

Building-up and Hard Surfacing by Welding, by William Andrews. (*Engineering, 19th November, 1943, Vol. 156, No. 4062, p. 418, 5 figs.*).

The building-up or surfacing operations in which welding is employed may be considered as serving three main ends, namely, (*a*) repair or reduction of abra-

sion in all its various forms ; (*b*) repair or reduction of corrosion of all types; and (*c*) reclamation of faulty material arising from poor workmanship or other reasons. The simplest material to deal with, of course, is ordinary carbon steel which, as far as bulk is concerned, still forms the greatest single item in engineering fabrication. Metals available for arc welding. Special-purpose electrodes. This first class of electrode includes both pearlitic and matrensitic alloys. The second class of electrode, giving deposits of very high hardness and special properties, is mainly directed to the deposition of weld metal having the properties of cutting tools and similar materials. Oxy-acetylene welding. Application of welding for corrosion resistance. Welding of non-ferrous metals. Welding of special alloys.

Conservation of Tin in Soft Solders, by D. L. Calwell and W. C. Lang, (*Sheet Metal Industries, November, 1943, Vol. 18, No. 199, p. 1921*).

In the absence of a plentiful supply of tin much of the work formerly done by high-tin solders can be just as satisfactorily performed by solders of alternative compositions containing either no tin at all or much less tin than was previously used. Typical compositions are given and suggestions are made for the proper handling of these various alternative compositions. Lead-tin solders. High lead-silver solders. Lead-tin-silver solders.

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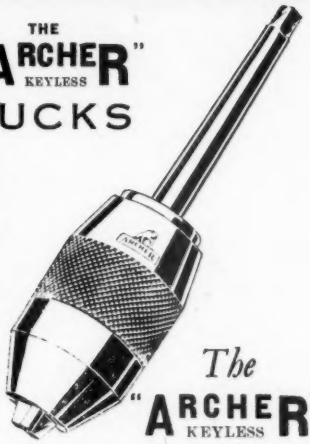

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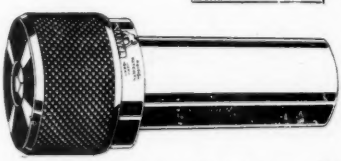

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